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THE
Curious and Accurate
OBSERVATIONS
OF
Mr. *Stephen Lorenzini* H.
Of *FLORENCE*,
ON THE
DISSECTIONS
OF THE
Cramp-Fiſh:

CONTAINING
The *Comparative Anatomy* of that and
ſome other Fiſh, with *Experiments*.

Dedicated to His Moſt Serene HIGHNESS
the Prince of *TUSCANY*.

And now done into *Engliſh* from the *Italian*, with
FIGURES after the Life.
By *J. DAVIS*, M.D. c.2910.

LONDON,
Printed for, and ſold by Jeffery Wale at the Angel in St.
Paul's Church-yard. 1705.

I have this booke in Italian with cutts but never saw one in English with them. Robt. Gray. M.D.

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Moſt Serene Prince,

SO Great is the Wiſdom which the Supreme Author of Nature hath ſhewn in that wonderful Work of the Univerſe, that there is no one Part of it, tho' never ſo ſmall, which is not ſufficient to raiſe Wonder and Admiration in the Mind of any one who ſhall attentively conſider it. Hence it is, that the moſt Noble Wits are never fully ſatisfied, in contemplating diſtinctly, and part by part, not only the Great, but alſo the Leſſer Products of Nature: For who is there amongſt them all, who after he hath viewed with an incredible delight and attention, the Heavens, which being embeliſhed with ſo many, ſo vaſt, and ſuch glorious Bodies are always glittering; the Earth, which for the Variety of its innumerable Products, ſeems, as it were, to vie or contend with Heaven it ſelf for Beauty; and other things full of Prodigies, and all theſe produced by the Great Cre-

ator, and governed by his Infinite Wiſdom and Providence: Who is there, I ſay, of theſe, that doth not turn the Eyes of his Mind, as well as thoſe of his Body, to the contemplation of Plants, Animals, and other leſſer things, being, as it were, wearied and tired out, in viewing only the Greateſt? Nor let any Man here imagine or fancy, that there is not as great a delight and ſatisfaction in the contemplation of thoſe ſmaller Bodies or Objects, as if the Divine Artiſt was not equally admirable in them, as in the Greateſt; ſince on the contrary, the infinite Art and Skill of that Divine Maſter, is ſeen or viewed more eaſily, and with far greater pleaſure in the moſt minute or ſmalleſt Creatures, they being ſo many Abridgments of his Works, or as it were Nature's Short-Hand; whence, according to the opinion of Pliny, *in theſe Nature doth more fully diſcover herſelf; ſince being more within the reach or ken of our Senſes, they are alſo more eaſily comprehended than thoſe great, ſublime, admirable, and chief Piece of the Divine Workmanſhip, which our ſhort-ſighted Eyes can no ways approach. Whence Natural Philoſophy, or that kind of Study which nicely conſidereth and examineth the ſeveral Works of Nature, hath* *been always cheriſhed and improved by foreign Wits, being always had in great Veneration, and eſteemed and always honoured by great and heroick Souls, as a world of Examples do ſufficiently demonſtrate, which I would willingly here produce, had I not here preſent the Example of your Moſt Serene Highneſs, which excelleth all others, who amongſt others of thoſe your moſt Noble Employs and Exerciſes, by which you are every day endeavouring to gain the Victory over your ſelf, and even over your own Grandeur, you alſo take no ſmall pains in that kind of Philoſophy; and in the flower of your moſt tender and green Years, your S. Highneſs yieldeth ſuch ripe and mature Fruits of Wiſdom, that even* Tuſcany *with an incredible Joy hath from thence conceived moſt certain hopes of enjoying one day, that Happineſs which the Divine* Plato *promiſed to thoſe People, who ſhould be governed by a Prince that was a Philoſopher; and not without reaſon, ſince the Mind of your Highneſs is of that Temper, which, as the Wiſe-man judgeth, is ſo requiſite and neceſſary for ſuch as govern, whoſe Nature he would have to reſemble the fineſt and moſt perfect Gold; and this is evidently confirmed by that Purity of*

Mind, that grave and ſedate Carriage (which is ſo wonderful in Youth) by the Fineneſs of your Judgment, your Docility and Sharpneſs of Wit, that your Sweetneſs of your more than ordinary Genius, that Noble Diſpoſition, which is truly Royal, that Splendour of Mind, or Generoſity, moſt worthy of a Principality and Kingdom, and above all other things, that mighty Application to Arts and Sciences, and that Love of Truth, which are ſo viſibly eminent in your Highneſs, which in all probability, by ſo great an Example, may ſtir up in the Mind of all others ſo great a deſire of thoſe Noble and Genteel Studies; as may once more reſtore to Tuſcany, *and eſpecially to* Florence, *their antient Glory and Renown, with freſh Applauſes. And this is a Truth of which I am moſt certainly convinced by what I feel in my ſelf, who by ſeeing your Highneſs ſo taken up in theſe Studies, am the more encouraged alſo to proſecute them, and conſidering night and day how I might give ſome mark of the extraordinary Devotion which I bear to your Highneſs, and of the paſſionate ambition I had to offer ſomething that might be acceptable to you, I judged I ought not to quit theſe kind of Studies; and thereupon having made*

made ſome Obſervations on the Nature of Cramp-Fiſh, I reſolved to conſecrate them to your moſt Serene Name; which Preſent or Gift, tho' it be mean in reſpect of the Weakneſs of my Wit, and the Poverty of my Stile, is no ways mean in reſpect of the Subject, ſince there is no Work of Nature that is really mean or baſe; but, as I have ſaid in the beginning, they are all to be looked on with wonder and delight: For if the Actions of Great Monarchs and Captains, which are related by faithful Hiſtorians, do affect us with pleaſure and admiration, with how much greater pleaſure ad admiration ſhall we be filled in contemplating the Works of God, which tho' ſome of them ſeem contemptible and mean to the Vulgar, are all of them very great and wonderful, as is the Nature of this particular Animal which I have undertaken to deſcribe, whoſe ſtrange Virtue or Property doth equally ſtupify the Minds of thoſe who conſider it, as it doth the Hands of theſe who touch it. VVhence ſeveral Treatiſes, perhaps from a great Admiration of it, abound with ſeveral Paſſages which are remote from Truth, on purpoſe to raiſe in the Minds of their Readers that VVonder which the Authors *themſelves had experienced, whoſe fabulous Relations I having laid aſide, have ſet down that only which I have found to be true, being very well aſſured, that if there be nothing in this Book, that may pleaſe your Highneſs, at leaſt the Love of Truth, which your Highneſs hath always befriended, will no ways be ungrateful to your Serene Highneſs.*

Your M. S. Highneſs's
moſt Humble,
moſt Devoted,
AND
moſt obliged Servant,

Stephen Lorenzini.

Lorenzini's

Lorenzini's Obſervations ON THE CRAMP-FISH.

THE ignorant and fooliſh *Abderites*, miſconſtruing the profound Knowledge of *Democritus*, as being above their reach and capacity, look'd on him, as one who was no better than a Mad-man. And his being ſo wholly wrapt up, in his Abſtracted Speculations, and perfectly weaned from thoſe poor Trifles, with which the common People are uſually amuſed, or entertained, was perhaps the true Occaſion, or Cauſe, that made his Wiſdom appear to them, as downright Folly or Madneſs: But the Caſe, in effect, was really otherwiſe; for the *Abderites*, by their Indiſcretion, groſs Ignorance, and Folly, ſufficiently demonſtrated to the World, that they themſelves were really mad, and not *Democritus*, who even, when he leaſt appeared to be ſo, was truly Wiſe and Prudent: And this the Divine *Hippocrates* teſtified to them, when being ſent for by them, to cure this great Philoſopher of his imaginary Diſtemper, he freely told them, that *Democritus* was very well, and ſo far from wanting the Advice of a Phyſician for his Recovery, that even he of himſelf was ſufficient to cure all the People of *Abdera*, and to reſtore them all to the perfect uſe of their Senſes: And this *Hippocrates* ſaid, becauſe the Actions of *Democritus* had nothing in them of a Fool, or a Mad-man, ſince his Time was wholly ſpent in Anatomical Diſſections and Obſervations, to which he ſo cloſely applied himſelf, that to others he appeared to be what he was not, nor was he thought to be what he really was; that is to ſay, one averſe to all other things, and entirely devoted to a bold and ſagacious Enquiry after Truth. Now after the Example of ſo Great a Man (let others ſay what they will) methinks thoſe Gentlemen cannot any ways be juſtly blamed or cenſur'd, who giving themſelves up to the Holy Love of Philoſophy, uſe all poſſible means to trace or find out the Cauſes of all ſenſible Effects, which are not ſo eaſily manifeſted to Human Underſtanding. And tho' I do not pretend to be one of These, nor can I even at a diſtance, ſtile my ſelf the Imitator of ſo great a Philoſopher; yet be it as it will be, what can hinder me from deſiring, at leaſt, to be ſo? And I muſt confeſs, ſuch a kind of Deſire, or Ambition it was, which diſpoſed me firſt, to make theſe my preſent Obſervations on a certain Fiſh, (called the *Cramp-Fiſh*) and afterwards to enlarge them in a Stile, perhaps not ſo polite as it ſhould be; yet very plain, and very ſincere. The Order or Method which I have here followed, is this: Firſt, I have deſcribed the outward Figure of the Cramp-Fiſh, with the Skin of it; afterwards I have obſerved what is ſeen under the Skin: Thence I have proceeded to the Obſervation of thoſe Parts, which are contained in the *Abdomen*, the *Thorax*, and the Head, reſerving my Diſcourſe on that ſo wonderful Virtue or Propriety, which by the Writers of Natural Hiſtory is generally aſcribed to the Cramp-Fiſh, for the laſt place. If theſe my Labours ſhall have the good fortune, as to meet with a kind Reception from the World, perhaps they will encourage me to attempt the publiſhing of ſomething new, and of a greater conſequence.

The Body of the Cramp-Fiſh, when the Tail is taken off, repreſents, as it were, a Hoop, with ſeveral Knobs in the circumference of it, of all which the moſt ſenſible is that, which is in the Forepart of the Head; tho' even This alſo in all Cramp-Fiſh, is not after the ſame manner. They are of a different bigneſs, and conſequently of a different Weight. I have ſeen ſome, which weighed only ſix Ounces, and ſome alſo, which have weighed eighteen Pounds. This Diverſity of their bigneſs and weight may perhaps proceed from their Age; but yet I am apt to believe, that they are of a different Race or Kind, that is, that there are little ones and great ones; for in ſome of them, by chance, of the leſſer Proportion,

tion, I have met with Eggs, in a manner, entirely perfect. *Johnſtonus* will ſcarce allow the greateſt Cramp-fiſh that is, to weigh above ſix Pounds; but he was certainly miſtaken: For beſides my above-mention'd Ocular Obſervations, Mr. *Nicolaus Steno*, my moſt Beloved Maſter, now Biſhop of *Titopolis*, and Vicar Apoſtolick in *Hannover* (who is equally famous for his great Knowledge in Natural Philoſophy, and profound Skill in Divinity) diſſected one of them, which weighed nine Pounds, as he himſelf relates, in the Acts of *Copenhagen* 1673: And the moſt Noble Mr. *Francis Redi* (who was alſo my moſt Honoured Maſter) in the Natural Experiments, which he writ to Father *Kircher*, relates, that he had diſſected one, which weighed fifteen Pounds; nay, and what is yet more, he ſaith, he had weighed one of twenty Pounds. Yet in theſe preſent Obſervations, I ſhall undertake to deſcribe only thoſe of a moderate bigneſs, which I have had the Opportunity to obſerve.

The Tail is ſhort, and formed in the likeneſs of a Cone, which as well above as below, is ſomething flattiſh or ſquaſhed; in whoſe upper part, are planted two Finns, or Wings, in a ſtraight Line, according to the Length of the ſame Tail. The Finn, which is neareſt to the Body, is bigger than that which is nearer to the extremity of the Tail; and the extremity of the Tail it ſelf is encompaſſed with a third Finn, which in ſome ſenſe is doubly forked, the upper part of the Fork being longer than the lower part. Theſe Three Finns are armed with ſome fine ſmall Cartilaginous Prickles, which are all covered with one common Membrane, which is in a manner of the ſame kind, with that Skin which covereth, not only the Tail, but alſo the whole Body of the Cramp-Fiſh; tho' that of the Finns is ſomething finer. The Tail there, where it is faſtened to the end, or extremity of the Back, is divided by two other fleſhy Finns, which ſeem to be rather two Lengthenings, or Allongations of the Border that goeth round the Body of the Cramp-Fiſh. The Cramp-Fiſh make great uſe of all theſe Finns in their Swimming, to which alſo the fine utmoſt Border, or Liſt, which encompaſſeth their Circular Body, doth alſo ſomething contribute; and even giveth them a greater force. For the future, or in the following Parts of this Diſcourſe, I ſhall mention this ſmall utmoſt Liſt of their Body, under the Name of the Side-Finns.

The Eyes are ſeated at two Fingers breadth diſtance, from the utmoſt Liſt, or Border of the Head on the Fore-part, which are not very big, and yet are ſomething different, as to their external Figure, according to the different Kinds or Species of Cramp-Fiſh, as we ſhall obſerve in a more proper place.

Behind the Eyes, there appear two Holes of an Oval Form, one at each Eye, which open into the Palat, or Roof of the Mouth; and through theſe Holes, the Cramp-Fiſh caſts back one ſmall Portion of that Water which enters into the Mouth of it. Theſe Holes in ſome Cramp-Fiſh, are of the ſame bigneſs as the Eyes are, and in ſome others they are leſſer; and yet I never ſaw them bigger in any one; tho' *Johnſtonus* (being perhaps deceived in this point) delivers it in his Writings, that they are uſed to be bigger than the Eyes themſelves. Theſe Holes do open, and ſhut, by the means of a certain Body, ſeated in that Angle of the Holes, which is neareſt to the Eyes, which is of a Cartilaginous Subſtance, being covered with a ſmall Piece of Skin, and moveth about its own Baſis, ſo, that it can ſhut, or open the above-mention'd Holes, as often as it pleaſeth the Cramp-Fiſh, or when he is forced to it; and they are commonly ſhut as often as the Cramp-Fiſh opens his Mouth, to receive the Water; and they are then opened, when his Mouth being full of Water, is ſhut in order to let ſome of that Water out; ſince, as I have ſaid before, one ſmall Portion of it paſſeth out at theſe Holes, and the remaining part of it is driven, or ſpirted out through the Holes of the Gills, which by the Vulgar, or common People, are called Ears.

On the ſide parts of the Back, and Belly of the Cramp-Fiſh, there appear the Lines, or Marks, of two hooked or bended Bodies, on each ſide one; which having turned back thoſe their Parts (which by Anatomiſts are called flat) one againſt the other, keep their Convex parts, ſtill turning towards the Circumference of the Body. Theſe hooked Bodies take up that Space, which is between the Side-Finns and the Gills, and betwixt the Head, even to the Parts about the *Abdomen*; and they conſiſt of a certain ſoft Subſtance, which ſeemeth to be compoſed of ſo many Bladders full of Water, and of different irregular Figures. I ſhall ſhew what this Subſtance is, there, when I ſhall diſcourſe of the Skin: And we muſt alſo obſerve, that all the Body of the Cramp-Fiſh is bigger in the middle, and more ſlender in the Parts round about it; and that the Parts, which are neareſt to the Tail, are fuller, and more puffed or ſwell'd, than all the reſt of the Body; and in the Inſide of them there lieth hid a certain Griſtle, which contributes much to their bigneſs.

All the Skin, which covereth the Back of this Fiſh, is full of an infinite number of Holes, whereof ſome are bigger, ſome leſſer; and the great ones, as well as the leſſer, have a Circumference, which is ſomething blackiſh; and they are more numerous according as they approach the Head, and the nearer they are to the Tail, the more their number decreaſeth, and the Skin of the Tail alſo is bor'd thro' with theſe Holes, which are there very ſmall: They are ſo ſeated, that thoſe leſſer ſort of them are neareſt to the utmoſt Liſt or Border of the Body, and the biggeſt are accordingly at the greateſt diſtance from the ſaid Border. To all theſe Holes there are immediately joined, as many Ridges, or Camper'd Furrows; and a Briſtle being thruſt thro' the Orifice of theſe Holes, paſſeth alſo into theſe Furrows, and by this demonſtrates, that they are ſo many little Pipes or Conduits, from whence there cometh out a certain Humour, which is ſomething viſcous, or clammy; and it is a thing worthy of your Obſervation, that as ſome of theſe Holes are bigger, ſome ſmaller, ſo alſo ſome of theſe Ridges, or Furrows, are alſo bigger or leſſer, the biggeſt whereof, are immediately joined to the bigger ſort of Holes, and the ſmalleſt to the leſſer. That Humour, which cometh out at theſe Holes (as I have ſaid) is very viſcous, and extraordinary clammy; yet ſuch as renders the Skin of the Cramp-Fiſh ſo ſmooth, and ſlippery, that one hath much a-do to hold them in ones Hand; and it hath the ſame effect on them, as Caulking hath on the Ships, which facilitates their Motion, and makes them paſs more glib on the watery Surface of the Ocean. Mr. *Steno*, hath obſerved, and exactly deſcribed the ſame kind of Holes, with the ſame Furrows alſo, in a certain Fiſh called the *Ray*, or *Skate-Fiſh*; but ſtill with this difference, that he obſerved only one kind of Holes, and thoſe the greater ſort; whereas I have obſerved, both great, and ſmall ones, having found them in all the Cartilaginous Flat-fiſh, which I have hitherto diſſected. Mr. *Francis Redi*, in his Treatiſe of Eels, which is not yet printed, hath alſo obſerved this difference of greater, and leſſer Holes, and hath deſcribed them very exactly; and beſides, he hath alſo obſerved, that the Briſtle being thruſt thro' the Hole, and paſſing along the Pipe or Conduit, which is placed under it, it cometh out from the ſame Pipe at the Orifice of the Hole which is neareſt to it. Beſides, he hath obſerved, that not only the Cartilaginous Fiſh, and ſuch as have no Scales, are furniſhed with theſe kind of Holes and Pipes; but alſo ſome Fiſh of the Scaly Tribe, as Pikes, Tenches, Carpes, Trowtes, Pearch, the Fiſh that is like a *Severn* Shad, the young Tunnis of a Year old; and many other kinds of Fiſh, ſcaly, and thoſe without Scales, Sea-Fiſh, and Freſh-water-Fiſh, have theſe Holes, yet always with ſome manifeſt difference, either as to their Bigneſs, Order, or Situation, and alſo Thickneſs, or Number, according to their different Race, or Kind; and what is more, as he hath obſerved, thoſe kinds of Holes, and Conduits, are either full of this Viſcous Humour, or contain in them nothing at all of it. Now of what Colour the above-mention'd Furrows may be, it could not be ſo well obſerved, becauſe for the moſt part, or generally ſpeaking, they are of the ſame Colour, with the outward part of the Skin: It is very true, that one may eaſily perceive, where, and how they paſs along, in which thing there is yet ſome difference, according to the diverſity of the Furrows, becauſe the biggeſt ſort of them being very prettily ranged, paſs on towards the Head, or to ſpeak more properly, they paſs from the Head towards the Holes; and this, as I conceive, for no other end, but that the Viſcous Humour, which is contained in them, by thus meeting with the Water, may be the more eaſily forced or driven thro' the Holes; but the leſſer kind of them paſs from the Holes towards the Back of the Animal, or even from the Back of the Animal towards the Holes: And all this appeareth more manifeſtly then, when the Briſtle is thruſt into both of theſe kind of Furrows, becauſe in the great ones, the Briſtle paſſeth on freely towards the Head, and in the leſſer kind of them, it paſſeth towards the Back, as if all thoſe little Furrows went on in a Line parallel to each other from the utmoſt Border of the Circumference of the Body, and perpendicularly towards the Back-bone, as towards the Diameter. Beſides, there is another difference betwixt theſe Furrows, or Conduits, which is this; that in the leſſer ſort of them, the Briſtle paſſeth no farther than two Fingers breadth, and on the contrary, in the bigger ſort of them, it paſſeth freely on, without reaching to their fartheſt extremity.

The firſt Figure, which is in the firſt Table, or Plate, ſheweth all that is ſeen in the Back of the Cramp-Fiſh, in which *a*, *a*, *a*, *a*, *b* ſheweth the Circular Body of the Cramp-Fiſh, in the circumference of which are formed many Inequalities, or uneven Places, but eſpecially in *b*.

c, *c*, *c*, The Tail of the Cramp-Fiſh, on whoſe upper part are planted the two Finns.

f, *g*, The Finn, which encompaſſeth the Tail.

h, *h*, The two fleſhly Finns, which divide the Tail in the middle.

i, *i*, The Eyes.

l, *l*, The two Oval Holes, which open into the Palate, or Roof of the Mouth.

m, *m*, *m*, *m*, *c*, *c*, The Lines, or Marks, of the two hooked Bodies.

n, *n*, *n*, *n*, Five black Spots, which appear on the Back of ſome Cramp-Fiſh. All the other Holes, which are not marked with any Letter at all, are the Holes, from which the Viſcous Humour proceedeth.

How theſe Furrows, or Conduits, are ſupplied with this Viſcous Humour, which cometh from them in ſo plentiful a manner, I ſhall ſhew in their proper place, when having taken off the Skin, I ſhall view, and examine them more exactly. But let no one imagine here, that there are not the ſame Holes on the ſupine part of this Animal, which, as I have deſcribed, are on the Back of it; ſince all the Hem (which boundeth the convex Parts of thoſe two hooked Bodies, which ſeem, as it were, to be compoſed of ſo many Bladders full of Water, and of ſeveral irregular Figures, which I have deſcribed before) is full of the ſame Holes, but yet of the bigger ſort of them, all ranged in exact Order, one after another. A Briſtle alſo being put into theſe, cometh out towards the Head, tho' it penetrates more inwardly than it doth in the Furrows of the Back.

In the ſame ſupine part, betwixt the two above-mention'd hooked Bodies, at ſome ſmall diſtance from the Extremity of the fore-part of the Head, is placed the Mouth, which in proportion to their Body, is extraordinary wide, tho' when it is ſhut, it ſeemeth to be little enough. I have diſſected one of them, which weighed eighteen Pounds. This had ſo wide a Mouth, that I could freely or eaſily put my Hand into the Stomach of it (as alſo Mr. *Francis Redi* hath obſerved, in that which he diſſected.) Whence one may clearly ſee, how much *Johnſtonus* was miſtaken, who ſpeaking of Cramp-Fiſh, maintaineth, that they have a ſmall Mouth: But perhaps he meant, the Mouth when ſhut, and not when it is open; in which reſpect he would have ſaid true, ſince, as I have ſaid before, it then appears to be little enough. In the middle Circle, or Circumference of the upper Jaw, and in that of the lower, there are ſeen ſeveral Rows of Teeth, placed after a confuſed manner, which are very ſmall, hard, crooked, and bending backwards towards the Jaws. *Ariſtotle* and *Johnſtonus*, in their Writings, do both aſſert, that theſe are formed after the manner of a Saw; yet I, in all the moſt exact Obſervations which I have made, and the frequent Uſe of Microſcopes, could never yet diſcover any ſuch Teeth. On the ſide of the upper Lip, there are ſeated outwardly two round Holes, which are very deep. Theſe, by moſt Authors, are commonly look'd upon, or thought to be, the Holes of the Noſe; and I am very apt to believe it, ſince the Membrane, which covereth their convex part (as I ſhall ſhew in its due place) receiveth certain Nerves from the Brain, like the Olfactory Nerves, which are ſeen in other Animals; and methinks theſe Nerves cannot poſſibly be deſigned for any other uſe, but the Function, or Senſe of Smelling. It is true, I am apt to believe, that the Senſe of Smelling, in theſe Animals, is very blunt and dull; and what maketh me believe it to be ſo, is the convex Superficies of the Cavity of thoſe Holes, which is extraordinarily plain, being no ways multiplied with Plates, nor with any other Body.

I believe there is no one, that is not fully perſuaded of this Truth, That the greater Degree, or Excellence of Smelling, doth wholly proceed from the multiplying of the above-mention'd Superficies: For ſhould we examine the inward Mechaniſm of the Noſe of Animals, one after another, we ſhould find in them no other difference, but that of the Multiplying of the Superficies, ſome Animals having it more multiplied, ſome leſs; and of theſe, ſome have their Senſe of Smelling more ſharp or quick, ſome not ſo ſharp; and thoſe Animals, which have a quicker Smell, have the ſaid Superficies more multiplied, than thoſe whoſe Smelling is not ſo ſharp or quick. This is a point confirmed from *Greyhounds*, and all other kinds of Dogs, which, as every one knoweth, have a moſt exquiſite Smell; and in theſe, ſhould we examine the inward Superficies of the Cavity of their Noſe, we ſhall find that it is wonderfully multiplied by the means of ſeveral Bony ſmall Plates, which ſhew us the wonderful Skill of that Supreme or Sovereign Artiſt, in multiplying a Superficies ſo much, in ſo little a ſpace. The Bear, who hath, as quick, and perhaps a quicker Smell, than any other Animal, hath the inward Superficies of his Noſe, very much multiplied; and this is the reaſon of it, for the bigger and larger the Superficies is, the greater number of Particles or *Æffiuvia's* may there make an Impreſſion; and the more numerous the Particles are which make an Impreſſion on the Superficies, the more perfect, quicker, and more ſharp is the Senſe of Smelling: Whereas, on the other ſide, thoſe Animals, the inward Superficies of whoſe Noſe is not ſo multiplied, the fewer the Particles are, to make an Impreſſion on it, and conſequently the more blunt, and more imperfect is their Smelling. But as to this, I hope I ſhall be able to ſay ſomething on ſome other occaſion, being here only diſpoſed to inſinuate by the by, the inward Mechaniſm of the Noſe of a Bear, which I have obſerved not long ſince, by the occaſion of a Bear, which the Moſt Serene Prince of *Tuſcany*, my Maſter, out of his Generoſity, gave me, in order to have it Anatomiz'd: And this is it, which followeth.

In the Noſe of this Animal, in the Paſſage of the Superficies, there are reckoned more than thirty Spaces of ſmall Plates, which are ſo ranged, that four Plains, or Grounds of little Plates, couchant, or flat, are ſeparated from each other, by the means of three perpendicular Plains.

The firſt Plain is ſeated in the Superficies of the Noſtrils, on which two perpendicular Plains are ſeated.

In the ſecond Order of Plains, there are counted, two other Plains, one whereof is ſmall, and very ſingle, and the other is the common Baſis of the other Plains, and ſeven ſmall Plates are ſeated upon this perpendicularly.

The third Row of Plains, is compoſed of five Plains: And

The fourth Order, or Row, conſiſteth only of two Plains.

But let us now return (after this Excurſion) to the Cramp Fiſh again. The *Podex* is ſeated in that part, where the Tail is fixed to the Body of the Cramp-Fiſh, with a Cleft large enough, which towards the Head, and towards the Tail, ends in an Angle. On both Sides of the Angle, which looks towards the Tail, there appear two hooked Holes, in the Lips of the very Cleft. The Angle which looks towards the Head, is as it were covered over again with the Skin, which formeth a *Parabola*, that is to ſay, is ſtretched out on this ſide, and on that, towards the Side of the ſame Cleft. I have alſo obſerved the ſame kind of Mechaniſm, or Structure, about the *Podex*, in all the flat cartilaginous Fiſh, which I have hitherto diſſected; that is, in the Ray, the Maid-Fiſh, the Eagle-Fiſh, and the Falcon-Fiſh, which is alſo a kind of *Raia*, which by the Writers of Natural Hiſtory, is called, *Raia Oxythyncos major*, becauſe it hath in the fore-part of the Head, an Appendix that cometh out like a Bill. What theſe Holes are, and what uſe they ſerve for, I ſhall ſhew, when I ſhall diſcourſe of the inward Parts. In the very ſame Plain of the *Podex*, at the inward Sides of thoſe hooked Bodies, which conſiſt of a certain ſoft Subſtance, which ſeemeth to be compoſed of ſo many Bladders full of Water, of ſeveral irregular Figures, which I have mentioned before, there are open ten Holes, five of a ſide; which Holes being alſo of a hooked Figure, and turning their Horns, or Ends, towards the *Podex*, are thoſe which go to the Gills, and are covered over with ſuch folding of the Skin, as hinders or prevents the Water, which is once caſt forth at theſe Holes, from returning again into them. The Colour of this folding is very like the Colour of the Mother Pearl; but we muſt not truſt much to Colours, becauſe they often change, according to the Places where the Fiſh are taken, and according to the Motions, or Vibrations of the Air, as Mr. *Redi* hath alſo obſerved in his Treatiſe of Eels, which is not yet printed.

The ſecond Figure, which is in the firſt Table, ſheweth or repreſenteth the Breaſt, and *Abdomen* of the Cramp-Fiſh: And in this,

a, *a*, *i*, particularly expreſſeth the two hooked Bodies.

b, The Mouth.

c, *c*, The Hole of the Noſe.

d, *d*, The Holes of the Gills.

e, The Hole of the *Podex*, with the two little hooked Holes which are imprinted in the Lips of it.

Having now finiſhed the Deſcription of the outward Parts, which are equally common to all the ſeveral kinds of Cramp-Fiſh, I ſhall treat of ſome other Differences at preſent, which appear in the outward Parts, comparing one Cramp-Fiſh with another.

The Writers of Natural Hiſtory have diſtinguiſh'd the Cramp-Fiſh into two kinds, that is, into black, and reddiſh, or to ſpeak more properly, near the Colour of Sinople, or red Oaker. That Great Philoſopher hath added a third, which he calleth *Spinoſa*, or Prickly: But becauſe this Diviſion could not be conveniently relied on, as being not true, nor perfect in all reſpects; other Authors have formed another Diviſion, by which they diſtinguiſh'd the Cramp-Fiſh into black, and not black: And to this Diviſion, they added another Sub-Diviſion, which diſtinguiſhed the black again into two ſorts. Of the firſt kind were thoſe, which had on their Back only five black Spots; which ſaid Spots, becauſe they are ſomething like Eyes, gave *Pliny* the occaſion to call them, the Eyed Cramp-Fiſh; and *Bellonius* ſubſcribed in this point to *Pliny*. The other kind, are thoſe, which having no black Spots at all, have yet ſpread over all their Back abundance of white Spots of ſeveral different Figures. Beſides theſe above-mention'd Differences, I have obſerved ſome others, the firſt of which is this; That thoſe five black Spots, which are found on the Back of ſome Cramp-Fiſh, are not all of them of the ſame Figure, as ſome Authors pretend, who ſay they are round; but ſome of them are exactly round, others again are of a Figure which is more or leſs Oval. Beſides, there are ſome Cramp-Fiſh, in which one of the Spots is formed like a Half-moon: In ſome others the black Spots are ſo ſeated, that if their Centers were joined together with ſtraight Lines, they would thus form a *Pentagon*, tho' not exactly regular: In ſome others, theſe kind of Spots are placed only in two ſtraight Lines, which are parallel to each other; ſo that the three foremoſt are in one, and the two laſt in another. And we muſt alſo obſerve, that amongſt thoſe Cramp-Fiſh, which have five black Spots, there are ſome of them, who have all their Backs beſpeckled alſo with abundance of white Spots alſo of different Figures, like thoſe of the other Cramp-Fiſh, which have none of theſe five black Spots.

Beſides, in theſe the Colour of the Skin of the Back is of an Aſh-Colour, and in thoſe others, which have no Spots at all, it is reddiſh, or of the colour of Ruſt.

The ſecond difference is, that ſome Cramp-Fiſh have their Tail placed in the midſt of the two Appendixes, which are, as it were, round, and longer, or ſhorter, according to the bigneſs, or leſſer Proportion of the Animal.

The third Figure, which is in the firſt Table, repreſents a Cramp-Fiſh to the Life, as he lieth on his Back, with his Tail betwixt the Appendixes; and in this, *a*, *a*, ſhew the Appendixes.

In the greateſt, or biggeſt of thoſe which I have diſſected, they were no longer than four Fingers breadth, and about the bigneſs of the Little Finger. Theſe ſaid Appendixes are hard, and as it were bony, and in a manner, conſiſting of ſo many little Plates, put one upon the other. In that part, which looks towards the Tail, they look like Cleſs, or Chinks, and in that Extremity, which regards or reſpects the Extremity of the Tail it ſelf, they have a Hole, into which if a Briſtle is put, after when it is come to the middle, or half way of that Appendix, it paſſeth no farther, becauſe it hath no other Paſſage for it to go out at; ſo that one may properly call them, the blind Conduits, or Pipes. Thoſe Pipes contain within them a certain Subſtance like Milk; but what that is, and what uſe it ſerveth for, or how it is brought there, it is very difficult to gueſs, and much more to determine. All other flat Cartilaginous Fiſh, which I have hitherto had the opportunity to ſee, have alſo the ſame kind of Appendixes, of the ſame Form or Figure in their Structure; and I particularly obſerved them laſt Year at *Leghorn*, in the Eagle-Fiſh, (or *Pipiſtrello*, as they call it) the Maid-Fiſh, the Ray, and Falcon-Fiſh; and they have been alſo obſerved by other Authors, excepting the Cramp-Fiſh, becauſe perhaps they never met with any of thoſe Cramp-Fiſh, which have ſuch kind of Appendixes. Theſe ſame Authors are of an opinion, that they are a moſt certain Mark of the Male Kind; but how much they are deceived in this point, and how far from Truth they wander, is clearly evident from all thoſe flat Cartilaginous Fiſh, which have alſo theſe Appendixes, and yet hide within their Belly, thoſe Parts of Generation which are appropriated to Females, as I have frequently obſerved the laſt Year, both at *Piſa*, and at *Leghorn*, not only in the

Cramp-Fiſh, but alſo in the Maid-Fiſh, the Eagle-Fiſh, the Falcon-Fiſh, and Ray; in all which Fiſhes I found the *Ovaria*, or Egg-Caſes, and the *Oviductus*'s full of Eggs, and in ſome of that bigneſs, that it was impoſſible to be impoſed on in this point, becauſe ſome of them were as big as the Yelk of one of our Hens Eggs: So that laying aſide this Mark, or Token, which ſome Authors admit, in order to diſtinguiſh the Males from the Females, there remaineth no other Sign or Mark outwardly, at leaſt as I have obſerved, that can diſtinguiſh one Sex from the other.

The third Difference is, that ſome Cramp-Fiſh have their Eyes rais'd up above the Head, like Bubbles (as Mr. *Francis Redi* obſerved in his Cramp-Fiſh) as he writeth in his Letter to Father *Kircher*, and I alſo have frequently obſerved. In ſome others I have thought, that their Eyes were not raiſed at all, or very little, but rather ſhut up within their Caſes, tho' I muſt confeſs, that there are ſome whoſe Eyes are only raiſed up a little in the fore-part.

The fourth Difference is this, that in ſome Cramp-Fiſh, the Liſts, or Borders, of thoſe Holes which are immediately behind the Eyes, are made like ſo many Purles of Bone-lace, with ſeven Purles for every Hole; in ſome others, there is no ſuch thing; and as far as I have been able to obſerve, in all thoſe Cramp-Fiſh, whoſe Eyes are not raiſed up like Bubbles or Bliſters, the Holes behind their Eyes are formed Purle-wiſe, there being no ſuch thing in any of the reſt. Theſe are the Differences which I have obſerved, beſides what other Authors have remarked. Having now compleated, or explained, every thing which belongs to the outward Figure of this Animal, I ſhall go on, in order to deſcribe all the other things, which according to the Method of Anatomical Diſſection, are next to be explained or demonſtrated.

Beginning then to ſeparate the Skin from the Muſcles of the *Abdomen*, which lie under it, it is a pretty thing to behold, how ſeveral Tendinous Fibres, which are inſerted in the Skin, by paſſing croſs-wiſe, do cut each other alternately, thus forming a moſt curious *Plexus*, a Net, or to ſpeak more properly, a pretty Texture, or Weaving, of the fineſt Cloth; which alſo was very well obſerved by Mr. *Steno* in his Anatomy of the Ray-Fiſh. It is alſo a very great Curioſity to ſee, how that from all Parts of the whole Body, there cometh an infinite Number (as I may ſo ſay) of Tendinous Fibres, and a world of Nervous Fibres, and Capillary Veſſels alſo, in order to their being inſerted in the Skin; all which things do very well ſhew, that they have a great ſhare in the Compoſition and Texture of the ſame Skin: And becauſe ſuch a kind of Mechaniſm is obſerved to be about the Skin of all Cartilaginous flat Fiſh, methinks that one may poſitively affirm, that the greateſt part of the Skin is only a Texture, or Compoſition, of Tendinous and Nervous Fibres. Nor let any one imagine, that this Compoſition of the Skin is only to be ſeen, or met with, in theſe Fiſh; ſince Mr. *Steno* hath obſerved, that in all other Animals alſo, the Compoſition of the Skin is the very ſame with that which (as I ſaid before) is found in the Cramp-Fiſh; or which I very well obſerved (*Feb.* 20th *A.D.* 1677.) in the preſence of Mr. *Francis Redi*, upon the occaſion of a great *African* Lizard, which was diſſected at his Houſe; in the Skin of which Lizard, it was evidently, or plainly ſeen, that at every Scale there paſſed a vaſt number of Tendinous Fibres,. in order to their being inſerted in the foreſaid Skin. Moreover in Man alſo the Skin is joined with the Tendons, not only in the *Linea Alba* of the *Abdomen*, but alſo in the Elbows, Hands, and Feet; and this I have frequently demonſtrated at *Florence*, in the Hoſpital of *Santa Maria Nuova*, to ſome of my deareſt Friends; and this is a Truth ſo clear and evident, that it leaves no room for any one to doubt of it.

When the Skin of the lower and upper part of the Body is taken off, there appear on the Back, about the convex parts of each of thoſe hooked Bodies, which are compoſed of a ſoft Subſtance, conſiſting, in all appearance, of ſo many Bladders full of Water, of ſeveral irregular Figures: There appear, ſay I, two little Bundles of ſmall Pipes, on each ſide one, which ſaid ſmall Pipes being couched, or reſting on the Muſcles of the Back, and ſeparated in their Length from the Skin; when that ſame Skin is ſeparated, it is obſerved, that at one Extremity they diſcharge themſelves into thoſe greater Holes, which, as I have ſaid before, are found in the ſame Skin; and at the other Extremity, they are all of them terminated together in a certain place, which is betwixt the Eyes, and the utmoſt Border or Extremity of the fore-part of the Head, betwixt two bony Appendixes of the *Crannium*, which, like two Horns, do bud or ſprout forth from the ſame *Cranium*. Every one of theſe little Pipes, by the means of this Extremity, is ſeparately or diſtinctly faſtened to a ſmall Globe, about the bigneſs of a Coriander-ſeed; and all theſe Globes float up and down in a white, yet viſcous or clammy Humour, in which they are immerſed. The Subſtance of which theſe Globes are compoſed, reſembleth the Chryſtalline Humour of the Eye; as doth alſo the Subſtance of the ſame Pipes, ſince the Globes, and Conduits too, are found of the ſame Subſtance. The number of theſe kind of Conduits thus gathered into two ſmall Bundles, is proportioned to the number of thoſe great Holes, which appear in the outward parts of the Skin; and as there are more of the foreſaid Holes towards the Head than there are towards the Tail; ſo alſo there are more of theſe Pipes towards the Head, than there are towards the Tail. It is true, that theſe Pipes, which are more numerous towards the Head, are at the ſame time ſhorter than thoſe which are not ſo numerous, ſince all of them, as I ſaid before, have one End or Extremity in one ſame place, and the other in ſeveral places. What is ſaid here of theſe Pipes, will be better underſtood by means of the fourth Figure, which is in the firſt Table, in which

a, *a*, *a*, *a*, *a*, *c*, *c*, repreſent thoſe Pipes or Conduits which have been here deſcribed, and terminate in the Skin.

b, *b*, The place where the aforeſaid Pipes, with their other Extremities, are united to the Globes, which are deſcribed before.

The uſe of thoſe Pipes, as I have already hinted, is to convey that Humour, which uſually cometh out at thoſe Holes, into which thoſe very Pipes do diſembogue or empty themſelves. Now whence this Humour cometh into theſe Pipes, is a point here to be conſidered; I am apt to believe it is derived from thoſe Globes which I have mentioned before, and which reſemble the Coriander-ſeed, which ſerve as ſo many conglomorated Glandules, for the ſeparating or ſtraining of the ſame Humour; becauſe it is certainly true, that all thoſe Veſſels, in that very place where their Extremity is lodged, do either take in or let out ſome Humour, which is contained in them. Theſe Veſſels are terminated in thoſe Globes; therefore they receive ſome Humour from them, or in them they depoſe ſome Humour, which is contained in them: But, as we have ſeen, thoſe Veſſels let out the Humour which is contained in them, at thoſe Extremities, which enter into the Holes of the Skin;

whence we muſt needs conclude, that they derive their Source from thoſe Globes, and conſequently that theſe are the Machines, or Strainers appointed to ſeparate it. Beſides, the vaſt number of Blood-Veſſels, which ſpread their Ramifications thro' the Superficies of theſe Globes, ſeemeth evidently to demonſtrate this Truth; ſince thoſe very Veſſels, being much more numerous than would be neceſſary for the pure nouriſhing of thoſe Globes, give one reaſon to think, that the foreſaid Humour is ſeparated from the Blood in thoſe Globes. Nor is it to be objected here, that the Humour which cometh out from theſe Holes, which open into the Skin, ſeemeth to be much more than can be ſeparated from ſuch ſmall Globes, ſince there are ſo many of them, that the number of them makes an atonement for their Smallneſs. But becauſe perhaps the number may not anſwer that vaſt quantity of Humour, we muſt conſider farther, that the Pipes themſelves, or to ſpeak more properly, the Sides of them, do help the Globes in the ſtraining of this Liquor or Humour. And becauſe this Conſideration of mine doth not appear to be altogether a pure Idea or Fancy, I will here ſet down the Motives which induced me to embrace it. The firſt Motive which I had, was my ſeeing, that the Sides of theſe Pipes are of the ſame Subſtances as the Globes are, tho' ſomething of a different Colour, which is not enough to conſtitute any difference in their Subſtances, becauſe the arguing or infering any difference of the Subſtance of the Parts from their Colour, is no ways ſolid, and very incertain; and thoſe Parts which for the moſt part are red, by reaſon of the Blood, may grow yellow thro' the occaſion of the Bile or Choler; and the Muſcles in ſome Animals appear to be ſometimes red, ſometimes white: And even in the ſame Foot of a Rabbit, I have obſerved that the Muſcles were white and red, and yet both of them were of the ſame Subſtance, and ſerved for the ſame Uſe or Office. Whence it clearly appeareth, that there is no infering any diverſity of Subſtance in the Parts, from the different Colour of them.

My ſecond Motive is taken even from the Sides of the ſaid Pipes, which being much bigger than is neceſſary for one ſingle Conduit, make me doubt whether they were not deſigned for ſome other more ſecret Uſe, ſince the Works of Nature are never made by chance, nor are her Beings multiplied without ſome Neceſſity; ſo that if the Uſe of the Parts is determined or known from the Subſtance of which they are compoſed, or from the reſemblance that Subſtance hath with any other Subſtance, we muſt neceſſarily conclude on what I ſaid or aſſerted before, that is, that the Sides aſſiſt or promote the ſtraining of the Humour in thoſe Globes, ſince they are both compoſed of one and the ſame Subſtance.

My third Motive is derived from my obſerving, that all over the outward Superficies of theſe Pipes, there run a vaſt number of Blood-Veſſels, which are divided into an infinite number of the ſmalleſt kind of Ramifications; to which ſaid Veſſels I can aſſign no other uſe, than the carrying thither one part of that unctuous clammy Humour, together with the Blood; to the end that in thoſe parts, it may be ſtrained or ſeparated from the ſame Blood. But be it how it will, tho' all theſe Motives ſhould prove weak and groundleſs, which yet I look on as true and ſolid, the Smallneſs of theſe Globes, in reſpect of ſo much Humour which is found in the Pipes, ſignifieth nothing; becauſe thoſe Globes, like ſo many ſmall Veins or Sources of Water, may by little and little let drop into thoſe Pipes, as into ſo many Store houſes, that Humour, which being inſenſibly gathered there, is afterwards driven out, when there is an occaſion or neceſſity for it. And theſe are the Motives which induced me to diſcourſe on the uſe of thoſe Globes and Pipes; yet always referring my ſelf to the better Judgment of thoſe who are more advanced or more experienced in Anatomical Speculations than my ſelf. But ſince I have here ſpoken of the biggeſt ſort of Furrows or Pipes, and have alſo determined or declared what uſe they ſerve for, it is now neceſſary, that I ſay ſomething of the leſſer kind of Furrows or Pipes.

Theſe leſſer kind of Pipes, even then, when the Skin is ſeparated from the Muſcles, do not reſt on the Muſcles of the Back, but are ſo ſtrongly faſtened to the Skin of the ſaid Back, that there is no poſſibility of ſeparating them, without tearing or breaking of them; and they form in the ſame Skin a very pretty Figure, ſince a Pipe winding it ſelf as well on the Left as on the Right, all about that place, where thoſe hooked Bodies are faſtened, which are of a ſoft Subſtance, which ſeemeth to be compoſed of ſo many Bladders full of Water of ſeveral irregular Figures, as I have often expreſs'd; (that place ſtill appearing by the Impreſſions which remain of thoſe kind of

Bladders) after it hath gone round them, returns within it ſelf; ſo that it alſo formeth ſuch another kind of Figure, like that which the ſame hooked Bodies do form: From thence a Ramification paſſing from the lower part of every of thoſe Figures, they go on, one on the Right part, the other on the Left, continuing their Courſe even to the utmoſt extremity of the Tail. Theſe two Pipes, that is to ſay, that on the Right, and that on the Left, have a Communication with each other by means of a Pipe that is of the ſame nature with them, which a little below thoſe Holes, which are behind the Eyes, paſſeth from one of the ſaid Pipes to the other. Beſides, from theſe two Pipes, as from two main or chief Trunks or Bodies, there go very many Ramifications of Pipes of the ſame kind, which are continued on to all thoſe little Holes, which, as we have ſaid, are ſeen in the outward parts of the Skin. The length of theſe Ramifications, at the moſt, is not above two Fingers breadth. The Figure which theſe Pipes form, will be the more eaſily conceived or underſtood, as it is repreſented to the Life in the firſt Figure of the ſecond Table, in which

a, *a*, *a*, *e*, *c*, Are the Holes of the Skin, thro' which the greater Pipes diſcharge themſelves.

b, *b*, *b*, *c*, *c*, The Ramifications of the leſſer Pipes, which are continued on, even to the leſſer Pipes of the Skin.

c, *c*, *c*, *c*, *c*, The whole Skin, which covereth the Back of the Cramp Fiſh.

That Humour which cometh out from the leſſer Holes of the Skin of the Cramp-Fiſh, is conveyed thro' theſe little Pipes; and this Humour ſeemeth to be ſomething thinner, and not ſo clammy, as that which cometh out from the greater Holes. I have been ſomething at a ſtand to conſider whence ſuch a kind of Humour could be conveyed into theſe ſmall Pipes, ſince, as it appeared to me, they had no Communication with any one part; but afterwards obſerving more nicely, that in that very part, with which the Pipes are faſtened to the Skin, the very ſame Skin ſerveth them as Sides, my Doubts were all in a manner vaniſhed; ſince I thought one ought to conclude, that they received it from the Skin, and that for this reaſon theſe Pipes ought to be called the true Excretory Pipes of the Skin; which ſaid Excretory Pipes are the fourth thing, which, as *Nicholas Steno* hath maintained, is neceſſary to the forming of the Skin; and this his Aſſertion is confirmed by this Obſervation of mine, ſince there are abundance of them ſpread up and down in the Skin of the Cramp-Fiſh: And tho' theſe Excretory Veſſels are obſerved not to be ſo manifeſt in Brutes, as well as Men; we muſt not yet deſpair, but that at one time or other they may come to be fully diſcovered, by ſome one that may be more ſharp-ſighted, and more venturous or hardy, ſince there are many Reaſons or Obſervations which diſpoſe one to believe, that there are ſuch there alſo; and I am not willing to produce them in this place, for fear of wandring too much from my purpoſe, or preſent Subject. It is very probable then, that this clammy Humour is carried or conveyed to theſe leſſer Pipes, from ſome *Glandulæ Miliares*, that is, ſuch Glandules as are of the bigneſs of the Millet-ſeed, analogous to thoſe which, as the ſameMr. *Steno* hath obſerved, are faſten'd to and ſpread thro' all the Skin of many Animals; and even, as he further obſerveth, that every Pore of the Skin hath its own Miliary Glandules, which either are bigger, as in thoſe who are ſick, or leſſer, as in thoſe are well; it is alſo bigger in thoſe who ſweat much, and often. There is a Nerve near theſe Miliary Glandules of the Pores running croſs-wiſe, as the moſt Judicious *Marcellus Malpighi* hath obſerved; and there is not only a Nerve near them, but alſo ſeveral Ramifications of Blood-Veſſels. Sweat is ſeparated every where from theſe Miliary Glandules, by which thoſe Nervous Teats (which the ſame *Malpighi* obſerved in the Fleſh, and which he looked on as the proper Organ of Touching) are kept ſoft, and from being too dry, or from their conſtant uſe, callous; whence, as he excellently well obſerveth, much Sweat generally floweth in the more ſenſible Parts; as for example, in the Soles of the Feet, the Palms of the Hand, the Arm-pits, *&c.* In the Cramp-Fiſh then, and in all other Fiſh, which have ſuch Pipes, or any thing like them, a good quantity of that Humour, which is ſeparated in the Miliary Glandules, is collected or laid up in the ſaid Pipes, and all together is caſt forth, as occaſion requireth, thro' theſe viſible Holes. And as for this point, I can by no means doubt of the Truth of it, ſince thoſe very Pipes, as much as I have been able to obſerve, have no Connexion, with any other Part, except the Skin, and conſequently cannot receive this Humour from any Part but the Skin: Whence it followeth, that tho' theſe kind of Glandules are not to be found in the Skin of all Animals, we ought, at leaſt of neceſſity, allow them in thoſe Animals, which have ſuch kind of Veſſels, or any thing analogous to them, ſince the Sides of theſe Pipes are not ſo formed, nor of ſuch a Subſtance, as may qualify them to be an Inſtrument of Separation, as we have ſaid it is, in the bigger ſort of Pipes.

We muſt now examine thoſe hooked Bodies, which are formed of a ſoft Subſtance, which ſeemeth to be compoſed of ſo many Bladders full of Water, of ſeveral irregular Figures. It is no difficult Matter to diſcover their Mechaniſm, ſince theſe very Bodies are nothing elſe but two very fine Muſcles, compoſed (as Mr. *Francis Redi* hath obſerved) of many ſoft and white Fibres, and ſomething bigger than a Gooſe-Quill, and of a Cylindrical Form. One Extremity of theſe Fibres is in the Skin, which covereth the Back; the other End or Extremity is in the Skin which covereth the Breaſt and the Belly of the Cramp-Fiſh, and there they are placed perpendicularly: And tho the Fibres themſelves are of a Cylindrical Figure, yet their Extremities are of ſeveral irregular Figures; and theſe are the Extremities, which by their Colour, Figure, and Situation, ſeem to be true and real Bladders; and for this reaſon I have hitherto called theſe two Muſcles, hooked Bodies, made of a ſoft Subſtance, which ſeems to be compoſed of ſo many Bladders full of Water of ſeveral irregular Figures. Theſe very Fibres, which compoſe theſe two hooked Muſcles, are alternately ſeparated by Fibres, which go croſs-wiſe, and receive manifeſt Nerves, which approach them croſs-wiſe; ſo that I have no doubt or ſcruple to call them the *Fibræ Motrices*, with this addition alſo, that thoſe which are before are ſhorter than thoſe which are behind. The manner how theſe Fibres are ranged or diſpoſed, and the Figure which their Extremities leave printed in the Skin, is ſhewn or repreſented in the ſecond Figure of the ſecond Table, in which

a, *a*, *a*, *a*, Sheweth the Portion of the Skin.

b, *b*, *c*, *c*, The Cylindrical Fibres, which paſs from that Skin, which covereth the Back, to the Skin which covereth the Breaſt and *Abdomen*.

c, *c*, *c*, *c*, The Marks which remain printed in the Skin, when the Cylindrical Fibres are taken off.

Having thus repreſented the Skin, and the Parts which are next under it, I muſt now paſs on to the conſideration of thoſe Parts which are contained within the Cavity of the *Abdomen* and the *Thorax*; and before we penetrate ſo far, we muſt not omit the conſidering how the Tendinous Fibres of the Muſcles of the *Abdomen*, which are ſeated in the oppoſite Sides, do cut each other, aſcending obliquely, as in the *Linea Alba*; to which Fibres proceeding obliquely, ſome other Fibres, which paſs croſs-wiſe, are joined, forming, as it were, ſo many Inſertions into thoſe Muſcles.

When the *Abdomen* is opened, there appeareth the *Peritoneum*, inner Rim of the Belly, of an extraordinary white Colour, which is ſo ſtrongly faſtened to the Muſcles of the *Abdomen*, that there is no ſeparating of it from them, without danger of tearing it; and it is a pretty thing to ſee a great quantity or number of Tendinous Fibres, which coming out from the Muſcles, go on in order to be inſerted in the *Peritoneum*; and they are ſo interwoven with each other, that all that which Mr. *Nicolaus Steno* hath writ of the *Peritoneum*, may be evidently demonſtrated and confirmed; that is, that it is compoſed of the Tendinous Fibres of ſeveral Muſcles, which by being interwoven with each other, together form or compoſe ſuch a Membrane. He believeth the ſame thing of the *Pleura*, the *Dura Mater*, and all the other Membranes, as well ſuch as are common as thoſe that are proper, or do belong to every particular Muſcle; that is, that ſuch Membranes are nothing elſe, but the Fibres proceeding from the Muſcles; and all this may be evidently demonſtrated, as I have frequently done it, not only on the Bodies of Men, but alſo on thoſe of Brutes, becauſe the *Peritoneum*, with its Fibres, paſſeth betwixt the Fibres of the *Linea Alba*, as alſo betwixt the Tendinous Fibres, which are about the middle of the *Diaphragma*, and goeth on to the very *Vertebræ*, or Joints of the Back. So alſo in the Cavity of the *Thorax*, the *Pleura* is faſtened to the Tendons of the *Diaphragma*, and to the ſhort or ſmall Ribbs, as alſo to other Parts. Thus the greater Membrane of the Brain, that is, the *Dura Mater*, is not only faſtened every where all about the *Cranium*; but beſides, the Fibres of it coming out at the *Satu-rei*, are continued to the Muſcles, which are ſeated in the oppoſite

Part: And thus the Subſtance of theſe three Membranes muſt needs be the ſame.

When the *Peritoneum* is taken off, the Liver appeareth, which by its Situation preſently draweth our Eyes to the viewing, or conſideration of it, becauſe it is divided into two Lobes, like two Hooks not much differing from each other, as to their bigneſs; and they paſs, one to the Right ſide of the *Abdomen*, the other to the Left, and are joined together in that part which is under the *Sternum*, or rather in their Baſis, by means of a very ſmall Strip or Selvedge, of the ſame Subſtance as the Liver is of, which was alſo obſerved by Mr. *Francis Redi*, in a Letter which he writ to F. *Athenaſius Kircher*. The Colour of the Liver in ſome Cramp-Fiſh is pale, in others grey, in others reddiſh. The little Bag of Bile is ſeated in the Right Lobe of it, which in proportion to the Animal, is Big, and of a Figure in a manner exactly round. The Colour of the Gall, which is ſhut up in its little Bag, in ſome Cramp-Fiſh is watery, in others of a perfect green, in others again of a dull green, and in others reddiſh; but in all of them bitter in the higheſt degree. This little Gall-Bag is not without its *Canalis Cyſticus*, which is joined to another *Canalis Hepaticus*; ſo that there are three *Canales Hepatici*, two of which come from the Left Lobe of the Liver, and the third proceeds from the Right Lobe, at a ſmall diſtance from the little Gall-Bag. This Pipe or Conduit, which cometh from the Left Lobe of the Liver, is joined or united in one and the ſame Trunk or Body, with one of thoſe two Pipes which come from the Left Lobe; the other which cometh from the Left Lobe, being united in one Trunk with the *Canalis Cyſticus*; and all theſe Biliary Trunks do empty or diſcharge themſelves into the Inteſtine, a little under or below the *Pylorus*, in the ſecond Angle, which is formed by the Pipe or Conduit of Nouriſhment. The Structure and Paſſage of theſe Biliary Pipes, or *Ductus*'s, are fairly repreſented in the third Figure of the ſecond Table, in which

a, Sheweth the Left Lobe of the Liver.
b, The Right Lobe.
c, The little Gall-Bag.
d, The *Canalis Cyſticus*.

e, The *Canalis Hepaticus*, which cometh from the Right Lobe of the Liver.

f, *g*, The two *Canales Hepatici*, which come from the Left Lobe of the Liver.

h, *h*, Two common Conduits, in which the four Biliary Pipes are united.

i, The Portion or part of the Inteſtin, into which the Biliary Pipes do diſcharge themſelves.

l, *l*, The *Ovaria*, or Egg-Caſes.

But ſince I have deſcribed ſo pretty a Structure in the Biliary Pipes of the Cramp-Fiſh, there cometh a ſudden Inclination in my Mind to deſcribe another very pretty one, which I have obſerved in another Animal, which tho' it be not altogether of the Fiſh-kind, at leaſt is one of thoſe Amphibious Creatures, which live partly at Land, and partly in the Water. The Moſt Serene Prince of *Tuſcany*, my Maſter, preſented me with a *Loatre*, in order to have it diſſected: In this, whilſt I, having the Liver of it in my Hands, was tracing out the *Porus Biliarius*, I did not only diſcover one, but many of them together, which being interwoven with each other, made a pretty Figure: And whilſt I thought there was but one folded into ſeveral Rounds, I began to ſeparate and take off all the Membranes, and all that which might any ways deprive me of ſo curious a Sight. The Membranes then being ſeparated, and all other Obſtructions removed, I perceived, that from every Lobe of the Liver, there came out a Biliary Pipe, or *Porus*, ſome of which diſcharg'd themſelves into the Neck of the little Gall-bagg, and others into the Cyſtick Conduit; yet every one apart by itſelf, with a Mouth or Orifice proper to it ſelf. All theſe Biliary Pipes or Conduits, were of different bigneſs; ſo that ſome were bigger, ſome leſſer, ſome longer, and ſome ſhorter. The biggeſt ſort of them came from the biggeſt Lobes of the Liver, and the ſmalleſt from the leſſer Lobes; and becauſe the number of the Lobes were ſix, there were alſo ſix Biliary Conduits, three great ones, and three ſmaller. When I at the firſt ſight obſerved thoſe Biliary Conduits, which were inſerted into the Neck of the little Bag of the Gall, I thought at that time, that the Gall was convey'd thro' theſe into the little Bag, and that by their means it was filled; but after I had well obſerved their opening into the Neck of the ſaid little Bag, I changed my Opinion, becauſe that Opening, or Orifice, did not reſpect the foreſaid little Bag, but the *Ductus Cyſticus*; whence it is evident, that the Gall doth not diſcharge it ſelf here to enter into the little Bag, but in order to be conveyed together, with that which cometh from the little Bag, into the Inteſtins, by ſome common Pipe, or Conduit. But to return to my Subject. The Stomach is ſeated betwixt the two Lobes of the Liver, which with its *Pylorus* (which is very ſmall) turning back upwards towards the *Diaphragma*, formeth an Angle, and thus paſſing in a manner even under the *Sternum*, turneth back again downwards towards the *Podex*; ſo that it repreſents the *Greek* Letter *Sigma* (as Mr. *Francis Redi* hath alſo obſerved): From thence a little after it is inſerted into the Inteſtine, which is directly joined to the *Podex*, as it appeareth in the fourth Figure, which is in the ſecond Table, in which

a, *a*, Repreſents the Stomach.

b, The ſhort Paſſage, which is betwixt the Mouth, and the Stomach.

c, *c*, The Inteſtine.

d, *d*, The Biliary Pipes.

e, *e*, The Paſſage which is betwixt the Stomach, and the Inteſtin.

f, The Milt.

g, The *Pancreas*.

In the greater ſort of Cramp-Fiſh, the Pipe, or Conduit thro' which the Food paſſeth, is about a Hand's breadth, and of three parts of this length, the Stomach takes up two. Thereabouts where the *Pylorus* is inſerted into the Inteſtin, there is a very ſmall blind Appendix of a reddiſh Colour, and hooked Figure.

The *Pancreas*, and the Milt, are ſeated in the firſt Angle, which is formed by the Food-Conduit, the Milt being faſtened to the Stomach, and the *Pancreas* to the *Pylorus*.

The Milt is greater, or leſſer, according to the proportion of the Animals; but it hath an Ellyptick Figure in all of them.

The Figure of the *Pancreas*, which is of a darkiſh white Colour, is irregular enough, ſince towards the Milt it is big, and large, and afterward with a certain long Slip it approacheth the Inteſtin, into which, by means of a Pipe appropriated to it, it conveyeth, or leaveth that Juice, which is ſeparated, by it ſelf, and by Writers is commonly called the Pancreatick Juice, and it depoſeth it, at a ſmall diſtance from the Orifice of thoſe two Biliary Conduits, of which I have treated before. There appeareth no Sign, or Mark, of a Tongue in the Mouth of it, as *Johnſtonus* alſo obſerveth; yet it appeareth that *Ariſtotle* might have been of another opinion, by what he writes in the Second Book of his Hiſtory of Animals, the Thirteenth Chapter. Καὶ πάντες ἔχουσιν ὀξεῖς τρία ὀδόντας καὶ Πολυστοίχους καὶ ἔνιοι ἐν τῇ γλώττῃ. Καὶ γλῶτταν ἔχουσι σκληρὰν καὶ ἀκανθώδη ἔχουσι καὶ προσποφυκυῖαν οὕτως ὥς ἐνίοτε μὴ δοκεῖν ἔχειν.

That is, that all Fiſh have ſharp Teeth, and ſeveral Rows of them, and ſome in the Tongue, and their Tongue hard and prickly, and ſo cloſely faſtened, that ſometimes they ſeem to have none at all. But Experience clearly ſheweth us, how much *Ariſtotle* was miſtaken in this point; for not only Cramp-Fiſh, but a world of other Fiſh have no ſuch thing as a Tongue, as every one may plainly ſee. Beſides, ſhould we examine all the Offices of the Tongue, one by one, we ſhall demonſtrate that Nature hath ſhewed a world of Prudence and Wiſdom, in depriving Fiſh of ſuch an Inſtrument as the Tongue, which would certainly have been of no uſe to them; in confirmation of which I ſhall here take care to produce ſome Arguments.

The Tongue then, which, according to the Diſcovery or Obſervation of Mr. *Steno*, hath its Texture compoſed of ſo many *Fibræ Motrices*. In the firſt place, I cannot any ways be induced to believe, that the Tongue was chiefly deſigned for Speech, ſince even all thoſe Animals, which are deprived of Speech, have yet a Tongue; ſo that I am apt to believe, that Speech is only a ſecondary or ſubſervient Uſe of it; as I am alſo on the other ſide very much diſpoſed to believe, that the main uſe of it is, by driving up and down, here and there, what the Animal taketh into its Mouth, to ſoak and moiſten it with ſome moſt proper Ferment; and having thus ſoaked and moiſtned it, to drive it down through the *Oeſophagus*. And I really believe, that there is no one hath obſerved, or can reckon up any other Uſes that the Tongue hath, beſides thoſe here mention'd. This then being ſuppoſed or granted, I cannot find out for what uſe the Tongue can ſerve in Fiſhes, ſince it can ſerve for none of thoſe abovementioned; ſince that Fiſh do not only, not ſpeak, or produce any Articulate Voice or Sound, and in one and the ſame inſtant tranſmit thoſe things which they have taken into their Mouth, without keeping them there at all, immediately into the Stomach, through that ſhort Paſſage, which is betwixt the Mouth and the ſaid Stomach. Let this be a Mark of it, or Counter-ſign, that Nature hath formed in the Mouth of ſome Fiſh, other diſtinct Rows of Teeth, which ſerve for ſome particular Uſes, and for this eſpecially; when at any time they ſwallow any other live Fiſh, as it generally happeneth, thoſe with all their wriggling cannot get back again, but are hinder'd and retained by theſe Teeth, ſince they are ſo formed, that they generally are bent towards or reſpect the Stomach: Whence it is, that their Food making no ſtay in the Mouth, and not receiving there any other Alteration at leaſt, as is evident to our Senſes; it is, I ſay, an evident Sign or Token, that it hath no need of being puſhed ſometimes on one ſide, and ſometimes on the other; and conſequently, that they have no need of a Mover for this purpoſe, that is to ſay, a Tongue. But it may be objected on the other ſide, that if the Tongue had no other Uſes than thoſe which I have here related, I ſhould perhaps have Reaſon on my ſide; but the Tongue having another Uſe, which is more common, therefore all I have ſaid on this Subject, is but a pure Maggot, or Whim of my own. The chief Uſe then which the Tongue is appointed for, is to perceive and diſtinguiſh the Taſtes of things; and that yet Fiſh being obliged to perceive and diſtinguiſh theſe Taſtes, it is alſo neceſſary in the higheſt degree, that Fiſh ſhould alſo have a Tongue, which is the proper Organ of Taſting. I am willing to allow of all this freely; and moreover I will to theſe add this Particular, that it is now a Truth as clear as the Sun, that the Senſation, which we call Taſting, is effected or performed by means of thoſe Tufts, or Teats, which have been diſcovered by Three of the moſt Learned Men of this Age, *Malpighi*, *Bellini*, and *Fraceſſati*; and I alſo at preſent am thoroughly convinced of this Truth, tho' there are ſome, who ſtill doubt, whether theſe kind of Tufts, or ſmall Teats, are the only Parts deſigned by Nature to receive this Impreſſion, or whether any other Part of the Mouth, or Roof of it, doth not alſo contribute to this Office. Now grant thoſe Tufts in the Tongue, are the Organ of Taſting, I retort the Argument, and aſſert, that thoſe Tongues, which ſhall not have any ſuch kind of Tufts on them, will not be capable of diſtinguiſhing Taſtes; and juſt ſuch are thoſe Bodies in the Mouths of Fiſhes, which are vulgarly call'd Tongues: And that thoſe kind of Bodies have no Tufts, is moſt clearly evident, as well from the daily Experience which one may make of it, as from the moſt Judicious Obſervations of Mr. *Fracaſſati*, who never ſaw theſe Tufts in that ſuppoſed Tongue of Fiſhes; yet he hath obſerved them, both in the Palate, and in the beginning of the *Oeſophagus*, and in the Gills. That Body then which is commonly called the Tongue in Fiſhes, having none of thoſe Tufts, which are the Organ of Senſation, cannot taſte, and conſequently being incapable of Taſting, cannot properly be called a Tongue. Of what force theſe my Arguments are, I can no ways pretend to determine, and therefore I refer them to the conſideration of thoſe who are more learned and more experienced than my ſelf, according to the Standard of whoſe Judgment I am always diſpoſed to change or alter my Opinion.

The Stomach is immediately joined to the Mouth, without any *Oeſophagus* intervening, conſtituting one and the ſame Cavity with the Mouth, which in proportion to the Animal, is large, according to what Mr. *Steno* hath obſerved in the Ray-Fiſh: For having put your Hand into that Cavity through the Mouth of the Cramp-Fiſh, you may turn it about without any difficulty at all; ſo that one may very eaſily conjecture how big thoſe Bodies may be, which the Cramp-Fiſh ſwallow down whole; and tho' that Cavity be ſome ſmall matter ſtraighter in the Jaws, than it is elſewhere, ſo that it ſeemeth to diſtinguiſh the Stomach from the Mouth with its ſmall Paſſage; yet this ſmall Paſſage doth no ways deſerve the Name of the *Oeſophagus*, ſince all the *Oeſophagus*'s, which I have hitherto diſſected, I have found them juſt ſuch as Mr. *Nicholaus Steno* hath obſerved, and deſcribed them to be; that is to ſay, compoſed of two Spiral Fibres, which ſaid Spiral Fibres are reduced to two kinds (that is, to a double Skrue) which meeting each other, do after that manner recipocrally cut each other; ſo that that which paſſed under the other, doth afterwards paſs over the ſame, till the Fibres meet each other again; whereas this ſmall Paſſage conſiſts only of one kind of Fibres, which (as Mr. *Steno* hath obſerved in the Ray Fiſh) not paſſing ſpirally, but circularly, do form that Paſſage, like ſo many Rings. The Stomach is formed after the ſame manner, and the Gut, or Inteſtin alſo; ſo that the whole Structure of the Pipe, or Conduit, through which the Food paſſeth, is altogether the ſame, contrary to what it is in other Animals, in moſt of which it differs according to the variety of Places and diverſity of Functions. Theſe Fibres, which like ſo many Rings, do form that Conduit through which the Food paſſeth, are very few in number, and no more than were neceſſary for the making a ſimple Pipe; ſo that it moſt evidently appeareth, that they only ſerve to ſtraighten and ſhrink up the foreſaid Pipe, when it hath no Meat in it, and to enlarge it, that it may ſuit or accommodate it ſelf to the Quantity or Figure of the Meat, which it taketh in to it ſelf. All theſe very ſame Fibres, which compoſe the Pipe through which the Food paſſeth, are outwardly encompaſſed with a Membrane, that is ſtrong enough. The Palate, or Roof of the Mouth, and the Jaws, are covered all over with a Glandulous ſort of Fleſh, which being preſſed, ſendeth forth at abundance of very ſmall Holes, a certain Humour, which, as it cometh out, is formed into little Balls, like ſo many ſmall Pearls; and being all of them afterwards united together, they form a little Maſs or Heap, which may be reſolved into Filaments, in the ſame manner as it is obſerved in the Filth of the Noſtrils. The Stomach, on the Inſide of it, is covered or lined all over with a great Cruſt, to that degree, that in ſome Cramp-Fiſh it is in a manner a Fingers breadth thick. This Cruſt being preſs'd, ſends forth through certain little Pipes a conſiderable quantity of a Humour, which is very Acid; which, when there is no Food or Meat in the Stomach, is joined together in ſuch a Form, as reſembleth the Vitreous Humour of the Eye. Whoſoever reflecteth attentively on the Structure of this Stomach, may come to be aſſuredly or certainly informed, after what manner that Diſſolution of Meat, commonly called Digeſtion, is performed; of which being to treat elſewhere (by God's Permiſſion) I ſhall here ſay nothing, contenting my ſelf only to inſinuate, that I ſhould, with the Leave and Approbation of my Friends, aſcribe it wholly to a Fluid, which is of two kinds; one kind is that, which ſweats, or drops from the Mouth, the *Oeſaphagus* and Stomach; and the other kind, is that Fluid, which is taken in at the Mouth in eating and drinking: And theſe two kinds of Fluids, when they are aſſiſted by the moderate Heat of the Bowels, perform the Work of Digeſtion, or Reſolution of Meat, which again, if the Heat is too ſtrong, or too weak, then there follows that Diſtemper, or Indiſpoſition, which is called Indigeſtion. I have found in the Stomach of Cramp-Fiſh, Sea-Thruſhes, Soles, Cuttle-Fiſh, and Lobſters, and ſeveral other ſorts of Fiſh, which being in a manner all conſumed, I was not able to diſcover what they were. And we muſt obſerve, that all thoſe Fiſh, which were found in the Stomach, were all over anoyated, and as it were, caulked with this Fluid, which (as I ſaid before) cometh from the little Pipes, or Teats, which are in the Cruſt or Coat of the Stomach. The Inteſtin is alſo lined with its Cruſt, but much finer, or thinner than that of the Stomach, and it is adorned or ſet out with a Hem or Welt, which is formed as of a double Skrue, which Welt is raiſed from the inner Coat of the Inteſtine, and is alſo covered o'er with a Cruſt of the ſame nature with that which lineth the Inteſtin. This Welt beginneth below the *Pylorus*, and is terminated or ends a Finger's breadth diſtance from the *Podex*. The ſame hath been obſerved by Mr. *Steno*, in the Ray-Fiſh, or Shate, and by Mr. *Francis Redi* in the Cramp-Fiſh alſo; and it hath no difference, as to its Figure, from what it is in the two *Inteſtina Cæca* of the Oſtrich, and in the *Inteſtinum Cæcum* of Rabbets. That Hem then, which formeth this double Skrue, is either larger or ſtraighter, according to the bigneſs or ſmallneſs of the *Inteſtinum*; and in ſome Cramp-Fiſh I have found it more than a Finger's breadth large. In every Cramp-Fiſh, as well great as ſmall, it maketh eight Rounds, and is compoſed of three Rows of Fibres, as alſo Mr. *Steno* hath obſerved in the Skate or Ray; that is to ſay, the two outward Rows aſcend obliquely from the Coat of the Inteſtine, even to the outward Liſt of the ſame Welt; and the third Row, which is betwixt theſe two, paſſeth according to length of the ſame Welt, tho' even this alſo doth not paſs altogether ſtraight. Not far from the Extremity of this double winding Welt, there appeareth outwardly a kind of Nervous Liſt, which is ſomething whitiſh, and is divided into Filaments, which, as I believe, are nothing elſe but the Tendinous Fibres gathered together again, and twiſted under them. This ſame kind of double Skrue I have obſerved in the Inteſtin of the Eagle-Fiſh, the Maid-Fiſh, and Falcon-

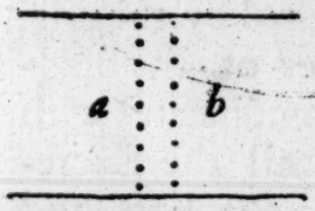
Fiſh, and in all of them it is compoſed of the ſame kind of Fibres. It is very true, that the Hem which formeth this Snail-Shell, is larger in ſome, and narrower in others, and in ſome methinks it hath more Rounds, in others not ſo many; but I dare not aſſert it for a certain Truth. What uſe this Snail Shell hath, is another Point; I ſhould believe, that it ſerveth for the ſame purpoſe, as the Length and winding to and fro of the Inteſtins, doth in other Animals. But ſince I have here deſcribed the Paſſage through which the Food paſſeth, I judge it may not be amiſs to anſwer two Queſtions, which may be ſtarted here, about the ſame Paſſage, and afterwards to lay down all the Uſes it may ſerve for.

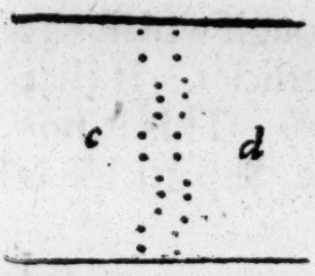
The firſt then of the foreſaid Queſtions is this: Why the foreſaid Paſſage in Animals is of that extraordinary Length? This Queſtion is not only anſwered, by that which ſome Men inſiſt on, who maintain, that this Paſſage is ſo formed to prevent too frequent Evacuations, which might ariſe from the Shortneſs of the Inteſtines; but one may here produce another general Anſwer, which may be applied to a general Queſtion which may be ſtarted, not only about the above-mention'd Paſſage, but alſo about many other Parts of the Body; that is, for what reaſon ſo large and vaſt a Superficies is very often ſhut up in ſo ſmall a Space; and this is particularly obſerved in the Coat or Membrane of the Noſtrils, which covereth the whole Superficies of all the Spungy Bones; alſo in the multiplying and diviſion of the Bloody Receptacle within the Lungs, the Liver, the Kidnies, the Teſticles, and *Ovaria*, or Egg-caſes; and beſides alſo in the ſtrange number of narrow Paſſages which are in the ſame Blood-Veſſel, which kind of Straights do alſo ſhorten the Paſſage through which the Food is conveyed. To all which things one only Anſwer is ſufficient; that is, that the only Reaſon why the Superficies is enlarged in the narrow Spaces, is this, that there might be a freer Communication betwixt the outward and inward Fluid; becauſe the Fluids being ſeparated from each other by means of a ſolid Body, they have no other Communication with each other, but what the Superficies of the ſaid ſolid Body alloweth them, which ſeparateth the ſame Fluids; in which caſe the ſmall Parts, which are contained in the midſt of the Fluid, it is true, do act violently on each other, but yet they cannot paſs to the neighbouring Fluid; and thoſe ſmall

Parts only, which are near, or to ſpeak more properly, touch the Superficies, endeavour to paſs, and find a Place which is fitted or ſuitable to their Figure: So that if afterwards the Superficies of that Solid, which ſeparateth the two Fluids, is ſo far encreaſed, that the Spaces of the Fluids become ſmall, then more of thoſe Particles of the ſame Fluids, come near or touch the Superficies of the Solid. And here one may eaſily conjecture whence it is, that they who drink by Sips are ſooner fudled than thoſe who ſwallow down great Cups at once (as it is commonly believed) becauſe taking into their Stomach a great quantity of Wine at once, all that which doth not touch on the Superficies of the Stomach, and *Oeſophagus*, cannot tranſmit its Particles into the Blood; but when one drinketh ſipping, and as it were by degrees, the Wine which is taken in at the Mouth, before it reacheth the Stomach, by grazing, as it were, with all its Particles on the Superficies of the Mouth, and *Oeſophagus*, conveyeth into the Blood all its more ſpirituous Parts. And from hence the uſe of that Diſtinction is manifeſted, betwixt the true Intrinſick Superficies, the Extrinſick, and middle one. as Mr. *Nicolaus Steno* hath defined it; for he diſtinguiſheth them from one another after the following manner. The true inward Superficies is that which is within the Cavity of the whole Blood-Veſſel, and eſpecially in the narrow Paſſages of it, which are in the Kidnies, the Lungs, and the Liver; as alſo of thoſe which embrace or encompaſs the Pipe through which the Food paſſeth, *c, c.*

The true external Superficies is not only that which is viſibly expoſed to the Eye, but it is alſo that which is continued or joined to that particular Superficies, which is viſibly expoſed to our Eyes by the means of the greater Holes, that is to ſay, all the Superficies of the *Aſpera Arteria* and the Lungs, which is touched by the Air, which cometh out by Reſpiration; all the Superficies of the Bladder and the Ureter; all the Superficies, which communicates with the *Matrix*, eſpecially in thoſe of twelve Years; all the Excretory Veſſels, which are terminated in the Mouth, the Ears and Noſe, *&c.* and all the Superficies of the Paſſage through which the Food paſſeth. The intermediate, or middle Superficies, is that which is betwixt the inward and outward Superficies. This is nothing elſe but thoſe Pores, by means of which one Superficies is communicated to another.

All that which is contained within the inward Superficies, is called the Inward Fluid by the ſame Mr. *Steno*; and that which toucheth the outward Superficies, he calleth the outward Fluid; and that which paſſeth from one Superficies to another, by the Pores, that is, by the intermediate Superficies, he calleth the Common Fluid. Now the Paſſage through which the Meat or Nouriſhment paſſeth, being comprehended under the Name of the outward Superficies, and the narrow Straights of the *Receptaculum Sanguineum*, which embrace the ſame Paſſage of the Food, under the Name of the inward Superficies; it happens out, that by how much longer that Paſſage is, through which the Food paſſeth, by ſo much more will the outward Superficies be encreaſed, and by conſequence the inward alſo; ſince the Ramifications will be much more numerous, that is, the narrow Straights of the bloody Receptacle, which embrace the ſame Paſſage through which the Nouriſhment paſſeth. From which increaſing of the inward and outward Superficies, it neceſſary follows, that the intermediate Superficies, or number of Pores be alſo multiplied; foraſmuch as theſe are things, which naturally follow each other, that is to ſay, where the Paſſage through which the Nouriſhment paſſeth is ſhort, there the Pores are but few; but on the other ſide, where that ſame Paſſage is long, there are abundance of Pores: But the Paſſage through the common Fiuid is more or leſs ſpacious, according to the Number of the Pores, and conſequently the greater or leſſer is the quantity of the Particles of the ſame common Fluid, which may paſs from the outward Fluid to the inward, or from the inward to the outward. But all this will appear plain, or more manifeſtly, by means of the Figures. In the Figure then let *a*, *b*, repreſent the *Solidum Rectum*, which divides the Fluids, and is porous at the ſame time. In the ſecond Figure let *c*, *d*, be the *Solidum Curvilineum*, that divides theſe two ſame Fluids, and let this be alſo porous; it is even viſibly evident, that there are more Pores in the ſecond Figure than there are in the firſt; and if the ſame Solid were more crooked, or folded into more narrow Places, the number of the Pores would ſtill be greater. So that it is very clear, that the only Reaſon or End for which





which Nature hath ſo much increaſed the Superficies of theſe narrow Spaces, was to preſerve the greater Communication betwixt the inward and outward Fluid. The Superficies then of that Paſſage through which the Food is conveyed, is encreaſed two ways, either when that ſame Conduit, by being lengthned, formeth more Rounds, as in four-footed Beaſts, and Volatiles; or when in a ſhorter or ſtraighter Pipe, there is placed all about the inward Superficies of the ſame, a certain Membrane that is formed after the manner of a Snail-Shell, as it hath been ſeen in the Cramp-Fiſh, and ſeveral other Fiſh.

The ſecond Queſtion is this, Why the Paſſage of the Food from the Mouth, even to the *Anus*, or Fundament, is not every where of the ſame Capacity or Dimenſion, but larger in ſome Places, and more narrow in others, as it is obſerved in ſome Animals, which for the moſt part have it enlarged in two places, that is, near the Mouth, and near the *Podex*; one of which Enlargements, or Dilations, that is near the Mouth, is called the Stomach, and is common to all Animals; the other, which is near the Fundament, and is commonly called the *Inteſtinum Colon*, all Animals have it not, but only ſome in particular. If we well obſerve or examine into the Actions of Nature, we ſhall clearly ſee, that theſe two Capacities, or Enlargements, do hinder thoſe things which are conveyed into them, from paſſing away too ſoon; whence one may ſay, that the firſt Capacity is made for this purpoſe, that thoſe things which are taken in at the Mouth, may have a certain place to ferment in for ſome ſmall time; and the other Capacity is formed for this end, that the Excrements may be retarded or ſtopped for ſome time in their Motion; nor can there any other Propriety be aſſigned to the foreſaid Capacities, than what their Figure and Situation do manifeſt unto us. And from hence we may draw two Arguments of the Providence of the Supreme or Soveraign Artificer. The firſt is taken from this, That he hath diſpoſed all things after that manner, that there is allowed a ſufficient time for the ſeparating all thoſe Particles from the Food which is taken in, that may be uſeful or ſerviceable to the Body. The ſecond Argument is taken from this, That he hath taken care and provided, that the Time which the Animal is to employ in other Actions, be not wholly ſpent in taking in what is neceſſary, or letting out what is ſuperfluous.

fluous. As for adding any thing more on this Subject, I ſhall leave it wholly to others.

Having then anſwered the two Queſtions, which have been propoſed about the Paſſage, or Conduit, through which the Food paſſeth, (to the beſt of my weak capacity) I muſt now aſſign, or mention, what Uſes this ſame Pipe ſerveth for, as I promiſed before.

This Conduit then, through which the Food is carried; Firſt, as to its common or intermediate Superficies, it ſerveth to keep up that reciprocal and continual Motion of thoſe Particles which are conveyed to the Blood, or come from it. Hence it is, that one is apt to feel a Fainting upon the want of Food, and a Recovery upon a ſufficient Supply of the ſame.

Secondly, As to the Capacity and Length of it, it ſerveth as a kind of Store-houſe or Magazine, thus giving a ſufficient time for the digeſting of the Food, and ſeparating the wholſome and nouriſhing Parts of it from thoſe which are ſuperfluous, as it alſo ſerveth for the maintaining a eaſier Communication betwixt the inward and outward Fluid.

Thirdly, As to the Cavity of it, it ſerveth as a Veſſel for the ſeparating or joining of the Parts of the Food.

Fourthly, In reſpect of the *Fibræ Motrices*, it ſerveth as the firſt Mover. As to the Largeneſs of the Stomach and *Colon* in Men, it ſerveth for this purpoſe, that the Time which is appointed for other Actions, may not be wholly ſpent in a conſtant taking in of what is neceſſary, or letting out what is ſuperfluous. But ſince perhaps by this long Digreſſion, I have wandred too far from my preſent Subject, it is now high time to return to it.

A little under or below the *Diaphragma*, there are ſeen on both ſides of the *Spina*, or Back-bone of the Cramp-Fiſh, two reddiſh Bodies, on each ſide one, being each of them cut or divided into ſo many ſmall Particles or little Glandules; and theſe are the Kidnies of the Cramp-Fiſh. And this kind of Structure of the Kidnies is not only found in the Cramp Fiſh; but in all other Fiſh whatſoever, all Birds, all Serpents, and in ſome four-footed Beaſts, as I have frequently obſerved in young Calves, Otters, and in Bears. I do not ſay any thing of the Kidnies of the *African* Lizard, nor of the Lizards of our own Country, which Mr. *Francis Redi* hath lately obſerved, becauſe I am not willing to be too prolix on this Subject; but I ſhall rather take the liberty to deſcribe here ſuch a kind of Structure, which is curious enough, and is found in the Milt of a certain Fiſh of the Dog-kind, which 1675, I diſſected with Mr. *Steno*, when I was at *Piſa*, and which I communicated in a long Letter to the abovemention'd Mr. *Francis Redi*.

The Milt of this Fiſh was two Ells and a half round about, being included within a Membrane, and it was compoſed of ſo many ſmall round Particles of the bigneſs of a ſmall Grape-ſtone. They were faſtened together by means of ſo many Blood-Veſſels, as there were in number Particles; and theſe Blood-Veſſels being afterwards united in one ſole Trunk, they ſo adjuſted the Particles, that they exactly repreſented, as well in their Structure as Figure, a very long Bunch of thoſe black Grapes, which in *Tuſcany* are commonly called *Abroſtoni* or *Raveruſti*. In Grey-hounds alſo I have obſerv'd the Milt divided into ſeveral Parts; neither did the Subſtance of theſe Bowels being thus divided, make any difference at all in the nature of them, ſince they are the ſame thing, and perform the ſame Functions, let their Subſtances be ſeparated or united under the ſame common Membrane, or let them be divided into Particles according to the Ramifications of the Blood-Veſſels.

The Kidnies begin, as I ſaid before, with an indifferent ſmall Extremity, a little under the *Diaphragma*, and growing larger by little and little, they paſs on towards the *Podex*; and in the greateſt Cramp-Fiſh their largeneſs is about a Finger's breadth. Their Length changeth, or varieth, according to the different bigneſs of their Bodies; but in all Cramp-Fiſh it takes up in a manner the whole Space of the *Abdomen*, paſſing all along the Sides of the Back-bone, being always ſtrongly faſten'd to the Back. Theſe Kidnies, with their Ureters, diſcharge or empty themſelves at thoſe two hooked Holes, which divide into two Parts the lower Angle of that Orifice, which, as I ſaid before, appeareth in the Situation of the *Podex*; ſo that a Probe being thruſt within theſe hooked Holes, penetrates even into thoſe two open Cavities of the *Abdomen*, into which Cavities the two Ureters enter, which ſame Ureters paſs underneath through the Kidnies, receiving a world of Ramifications from thoſe Particles, of which, as I ſaid before, the Kidnies are compoſed. I have obſerved the very ſame Structure, and Situation, as well of the Kidnies as of the Ureter, in all thoſe Cartilaginous Flat-Fiſh, which I have often mention'd before.

Having now done with the Organs which ſerve for Nouriſhment, the next things we are to conſider on, or examine, are the Organs of Generation, which have ſome difference in them according to the Age of the Cramp-Fiſh; for in the younger ſort of them, which as yet never had any Young Ones, nor are near the having of them, they are formed after one way, and in thoſe which have already brought forth Young Ones, or are near it, they are formed in a manner quite different. And to begin from the *Ovaria*, or Egg Caſes, theſe in the younger ſort of Cramp-Fiſh, as to their Figure, Bigneſs, Subſtance and Coverings, they are not very different from thoſe of the younger ſort of Women, or Maidens. They are ſeated in the upper part, or to ſpeak more properly, in the Baſis of each Lobe of the Liver, that toucheth on the Back; where having formed a ſmall Cavity, one part of the ſaid *Ovaria* is encloſed or ſhut up within that Cavity, the other part remaining without the ſaid Cavity, ſomething raiſed up. The Superficies of the *Ovaria*, or Egg-Caſes, is irregular enough, and by the means of ſeveral little Globes, uneven. They are covered and encloſed in one and the ſame Membrane, which tho' it is not very hard, is not yet very eaſily ſeparated from their Subſtance, becauſe it is ſo cloſely faſtened to it, that it ſeemeth to be all of a piece. The Subſtance of the *Ovaria* is chiefly compoſed of many Membranes and Fibres reciprocally united to each other, in the Spaces of which there are many little Bladders full of Liquor. Theſe little Bladders are the Eggs, and they are of the bigneſs of the Coriander-ſeed. The Subſtance of the *Ovaria* is ſpread all o'er with the Windings of abundance of Blood-Veſſels. The *Oviductus*'s and the *Matrixes*, in the younger Cramp Fiſh, thro' their whole Length, are of the ſame bigneſs, that is to ſay, of the ſame bigneſs with one of thoſe ſmall little Cords, which the Women of our Country are uſed to make of Sowing Thred; and they do not paſs on in a ſtraight Line, beneath through the Back, but bend a little to the Sides of the Animal.

In the greater ſort of Cramp-Fiſh, and in thoſe which have had Young Ones, or are near bringing forth, the Caſe is quite otherwiſe, becauſe the *Ovaria* being wonderfully encreaſed in bulk, contain within them Eggs of a different bigneſs, and of different Colours; for ſome of them are of a yellow Colour, and ſome of a white one; and ſome of them are as big as the Yelk of one of our Hen-Eggs. The Eggs are ſo placed in the *Ovaria*, that the leſſer are always ſeated in the middle, and are encompaſſed all about with thoſe which are bigger, to the end, that having thus a larger Space, they may the more eaſily be dilated, or encreaſe in bigneſs, juſt in that manner as the moſt Learned *Fabritius ab Aqua-pendente* hath obſerved in Hens, when he ſaid, that the greater or biggeſt Eggs in the *Ovaria* are placed as in a Bunch of Grapes, and ſeated in the Circumference, and the leſſer are placed in the middle, or encompaſſed by the bigger ſort, and that in fine, the leaſt of the Eggs are under all the reſt. And this only, that the Eggs when they encreaſe, or acquire a greater bulk, may be ſeparated from the reſt, in which Separation every one of the Yelks, beſides its own proper Coat or Membrane, borroweth another from the *Ovaria*, which ſurrounds the Eggs on the outſide, and connecteth them to that Body from whence they have their Origen or Riſe. The Yelk alſo receiveth the Nouriſhment for its growth from the ſame Body from whence it hath its riſe; which is ſomething analogous to that which *Hieronymus Fabritius àb Aquapendente*, calls *Pediolus* or *Pedunculus*; and therefore we may give it the ſame Definition that *Fabritius* gave to the other, to wit, that it is *Nexus Membranaceus cavatus, qui a Racemi fundamento ad Vitellum producitur, quem cum contingit, dilatatur, & (proinde ac Nervus Opticus in Oculo amplificatus) Vitellum externâ tunicâ obducit. Hinc forte Ariſtoteles* ϛόλον ὀμφαλώδη, *hoc eſt, Appendiculam Umbilicalem, & veluti Fiſtulam nuncupavit.* This Stalk of the Eggs carrieth with it ſeveral Blood Veſſels, which are ſpread or ramified in the ſaid Eggs. That Membrane or Coat which the Egg borroweth from the *Ovarium*, covereth the whole Egg, excepting only that outward part, which is directly oppoſite to the Stalk, where there appeareth a certain Line large enough, in which there appeareth no Blood-Veſſel at all, as *Regner de Graeff* hath well obſerved in Hens, contrary to the Opinion of *Fabritius ab Aqua-pendente*, who would have it, that this Membrane which the Egg borrows from the *Ovarium*, doth not encompaſs the whole Egg, but only that it covereth a little more than half of it, juſt in the ſame manner as an Acorn-Cup covereth the ſame Acorn, one part of the Egg remaining naked, and without any Membrane. But that the fore-part of it, or that which is fartheſt from the Stalk, is (as I ſaid before) deprived of this Membrane, is demonſtrated by putting a little Pipe into the Stalk, and blowing, by which the outward Membrane is extended by the Breath, which, as the ſame *Graeff* hath obſerved in Fowl, in Eggs which are not yet brought to their due Perfection, is ſtrongly faſtened to the inward Coat or Membrane; but in thoſe Eggs, which are already perfected, it is ſo eaſily looſened, and ſo dilated, that either the Egg falls down of it ſelf, or is driven forth by the Contraction, which the Fibres of the outward Membrane make; and this Egg, when it is ſeparated from its Stalk, is received by the Oviduct, and by that is conveyed into the *Matrix*, the outward Membrane with its Stalk continuing faſt to the Bunch; to which ſaid Membrane, becauſe it is like and correſponds with that which in Hens by *Aquapendente*, *Harvy*, and *Graeff*, is called the *Calix*, or Cups; I ſhall alſo give the Name of Cup. This *Calix* or Cup remaineth faſtened with its Stalk to the ſame Bunch, for ſome time after the Birth; but afterwards, in the very ſame manner as it is in the Hens, it vaniſheth by little and little. Which may be confirmed by what I have obſerved in ſome Cramp-Fiſh, in whom I have found ſome of theſe *Calixes* ſtill whole and big, and others more ſhrunk and ſhrivelled up, and others not ſo much; and that in ſome which really had brought forth their Young, I found none of theſe Cups: So that a little time after the Birth, one may know how many Young Ones the Cramp-Fiſh hath brought forth, from the number of theſe ſaid *Calixes* or Cups, and how long it is ſince ſhe brought them forth. I have never found more than ſix of theſe Cups faſtened to the *Ovarium*: So that I may eaſily infer, that theſe ſame Cramp-Fiſh may bring forth twelve at once. Not that I believe they cannot yet bring forth more, which I believe and look on as a certain Truth: But I ſhall never be diſpoſed to believe what *Ariſtotle*, *Pliny*, and other Writers of Natural Hiſtory do relate, who deliver it as a certain Truth, that there was a Cramp-Fiſh which had fourſcore Young ones at once, ſince much greater Organs would be required for ſuch a kind of Generation, and the Cramp Fiſh muſt have been of a very large bulk, ſince theſe very Cramp-Fiſh do not bring their Eggs out of their Body, but their Young Ones perfectly formed; and yet ſeveral of thoſe Writers of Natural Hiſtory, have delivered it down to us, that theſe ſaid Cramp-Fiſh ſcarce weigh above ſix Pounds. As to my own Opinion here, I am apt to think, that they themſelves were groſly miſtaken in one or other of theſe Aſſertions, or rather in both, ſince, as I ſaid before, they do not only weigh more than ſix Pounds, but alſo much more. Perhaps they who ſaw that Cramp-Fiſh, which had fourſcore Young in her Belly, ſaw her in the *Indian* Ocean, where Animals are commonly bigger than they are in our *Mediterranean* Seas.

Beſides thoſe things which, as I have related it, are found in the *Ovaria* of the Cramp-Fiſh which have brought forth, or are near the time of their bringing forth, there is alſo a certain Glandulous Subſtance, which is in a manner of the ſame Colour, which the Eggs themſelves have, tho' ſomething whiter. This Glandulous Subſtance doth ſomething reſemble that which *Regner de Graeff* hath obſerved in the *Ovaria* of four-footed Beaſts, which have been commonly taken for their Teſticles. I believe that kind of Subſtance ſerveth for the very ſame uſe which is aſcribed to it by the ſame *Graeff*, in the ſame Quadrupeds, that is, to help or facilitate the Separation of the Eggs from the *Ovaria*, and their Paſſage afterwards into the *Oviductus*'s; ſince that Glandulous Subſtance being found betwixt the Membranes of the Egg, encompaſſeth all the Egg, repreſenting the Figure of a Globe. The manner how this Glandulous Subſtance facilitates the Separation of the Egg from the *Ovaria*, or Egg-Caſes, according to the Opinion of the ſaid *Graeff*, is this: That it encreaſing by little and little, ſo preſſeth or ſqueezeth the ſame Egg all about, that at laſt it forceth it to ſlip through that Hole of the Membrane, which it borrows from the Egg-Caſes, and to fall into the *Oviductus*'s. Having now deſcribed the *Ovaria*, or Egg-Caſes, we muſt now make ſome mention of the *Vaſa Deferentia*, that is to ſay, of the Tubes or *Oviductus*'s, through which the Eggs do eaſily paſs to the *Matrix*; as it is neceſſary to deſcribe the *Matrix* it ſelf, in which the Young Ones are nouriſhed, and grow. As there are two Egg-Caſes, or *Ovaria*, ſo alſo there are two *Oviductus*'s ſeated on the Sides of the *Abdomen*, one on the Right ſide, and the other on the Left. Theſe *Oviductus*'s or Tubes take their riſe a little below the *Diaphragma*, and that on the Right, as well as that on the Left, recipocrally meeting each other croſs-wiſe, are joined together above the middle of the Stomach, making in a manner but one and the ſame Pipe, leaving ſtill, in the Place where they are united, an Orifice or Hole that is viſible enough, and ſo big, that one may put ones Finger in it. At this Hole it is, that the Eggs which are fallen from the *Ovaria*, paſs into the *Oviductus*'s or Tubes. Theſe *Oviductus*'s, in thoſe Cramp-Fiſh which have brought forth any Young Ones, or are near the Time of bringing of them forth, are of the bigneſs of a Man's Little Finger. The *Oviductus*'s, or Tubes, do afterward begin to deſcend from one part of the middle of the Stomach, ſometimes to the loweſt part of the *Abdomen*, and are joined to, or to ſpeak more properly, they enter into two great Bags or Purſes, which I call *Matrixes*, and which Mr. *Francis Redi* called the Bags of the *Oviductus*'s; which ſaid Bags are four or five Fingers breadth long, and three or four broad. Theſe *Oviductus*'s are diſcharged of their Eggs, and drive them into theſe Bags or *Matrixes* of the *Oviductus*'s, by means of a ſmall Pipe, or kind of Teat, which enters into the Cavity of the foreſaid *Matrixes*, about the Length of a Finger's breadth, and ſomething bigger than a Swan's Quill, and is alſo manifeſtly bored in the Point of it. This ſaid little Pipe or Teat ſerveth for this uſe, *viz.* to prevent thoſe Eggs which are fallen down from the *Oviductus*'s into the *Matrixes*, from going back again, or from returning into the ſaid *Oviductus*'s; and the better to qualify it for this Office, about a Finger's breadth diſtance from its Orifice, there are placed two Valves of a Circular Figure, and bending back towards the *Matrix*, of which, that which is neareſt to the ſmall Pipe, is ſmall enough: The other, which is placed higher than this, and conſequently at a greater diſtance from the foreſaid little Pipe, is much larger. I have obſerved the very ſame Structure in the Eagle-Fiſh, the Maid, and Falcon-Fiſh; but in the Maid-Fiſh there are three Valves, placed above the little Pipe, two of which, that is, thoſe which are neareſt to the Pipe, are indifferently ſmall; the third, that is, that which is higher than theſe two, and conſequently at a greater diſtance from this little Pipe, is a Finger's breadth large.

The Subſtance of the *Oviductus*'s conſiſts of two Membranes, one that is inward, and the other which is outward. The inward Membrane taketh its riſe from, or at leaſt communicates with that which lineth or covereth the *Matrixes* on the inſide. The outward Membrane communicates with that, which covereth the ſame *Matrixes* on the outſide; whence it is evident, that theſe *Matrixes* alſo are compoſed of a double Membrane, that is, an inward one, and one that is outward. The Subſtance which is contained betwixt theſe two Membranes, is like, and even the very ſame with that which Mr. *Nicholaus* hath obſerved and deſcribed in the Ray, that is, whitiſh, and not all of it after the ſame manner; for there are many Fibres, which are extended from the inward Membrane to the outward; and theſe kind of Fibres are longer in the middle, but towards the ſides, they by little and little, as it were, inſenſibly grow ſmaller. Beſides theſe Fibres, there is found on the ſides a certain Subſtance of the ſame as the Fibres are of, which in ſome reſpects is Glandulous. The outward Membrane of the *Matrixes*, which communicates with the outward Membrane of the *Oviductus*'s, is not always faſtened to the Subſtance of the *Matrixes*, tho' the outward Membrane of the *Oviductus*'s is always ſtrongly faſtened to the inward: For I have often found that outward Membrane of the *Matrix* wonderfully dilated, and in ſuch a manner, that it did not ſo much as touch any one part of the Subſtance of the *Matrix*, but juſt there where the *Matrix* reſts on the ſaid Membrane. I I have always found in the Cavity of this Membrane, which is thus dilated, a conſiderable quantity of thick Water, which was to the taſt Saltiſh. I ſhall preſently endeavour to deſcribe or explain, how it is poſſible for this Water to come in betwixt the Subſtance of the *Matrix*, and the outward Membrane of the ſame *Matrix*, of which at leaſt I ſhall give a probable Conjecture, tho' not a Demonſtration. I have ſaid before, that the Subſtance of the *Matrix* is much like a Glandulous Subſtance; whence I am now apt to fancy, that this Water may be ſeparated, ſtrained, and ſqueezed from this ſame Glandulous Subſtance: But for what Uſe this Water was deſigned, is a point which is very difficult to decide; whence I ingenuouſly conſider, that I am ignorant of it, tho' were I diſpoſed to diſcourſe on it, rather by way of conjecture, than out of any hopes of finding out the Truth, I might ſay or maintain, that by filling up theſe Cavities, it ſerveth as a Bolſter or Pillow for the defence of the Eggs, and *Fœtus*, as long as they are in the ſame *Matrixes*. And here I muſt obſerve, that I have found that Membrane thus dilated, that in thoſe Cramp-Fiſh, which had already brought forth their Young, or were near it, there was this difference, that in thoſe Cramp-Fiſh which had lately brought forth their Young, or were very near it, there was abundance of Water in the Cavity of that Membrane, but in thoſe Cramp-Fiſh which had brought forth their Young long before, there was not ſo much Water, and the longer or more time it was ſince they had brought forth their Young, there was ſtill ſo much the leſs Water; whence I believe, that after the Birth it waſteth by degrees, and vaniſheth altogether.

The *Matrixes* then, or Bags of the *Oviductus*'s (let us call them which you will) being made after the abovemention'd Form, are united with their Neck, and form one and the ſame Conduit, which like a Teat, entreth into a certain Receptacle ſomething like that which in Birds is called *Cloaca*, or Sink, tho' in the Cramp-Fiſh that Receptacle is ſeparated from the Inteſtine with a Membrane between. This Teat hanging down, as it were, viſibly or manifeſtly appeareth to the Eyes, when the Lips of that Hole are open, which (as I have ſaid before) is ſeated in the *Podex*, and hangeth down ſo much, that at the firſt ſight, it looks like the Member of Generation; but one may very reaſonably compare it to the Neck of a Human *Matrix*, which entreth into the *Foſſa Magna*. The ſame kind of Structure I have obſerved in all the Cartilaginous Flat-Fiſh, and particularly in the Eagle-Fiſh, the Maid-Fiſh, and Falcon-Fiſh. And for the better underſtanding or conceiving what I have hitherto ſaid of the Tubes and the *Matrixes*, I will produce two Figures, which are in the third Table marked with the Number 1, 2. The firſt ſimply repreſents the *Oviductus*'s and the *Matrixes*, in which

a, *a*, Shew the Tubes or *Oviductus*'s, which are united in *c*.

b, *b*, The two Holes, which are imprinted in the *Oviductus*, through which the Eggs paſs from the *Ovaria* into the *Oviductus*.

d, *d*, The Teats, or little Pipes, by means of which the Tubes diſcharge themſelves into the *Matrixes*.

e, *e*, The *Matrixes*, or Bags of the *Oviductus*'s.

f, *f*, The four Valves, two for each Oviduct or Tube, of which thoſe two which are marked with *f*, *f*, are bigger, and the two marked with *g*, *g*, are leſſer.

h, The common Conduit, or Pipe, in which thoſe Bags of the *Oviductus*'s, which open into the *Cloaca*, are united.

The ſecond Figure repreſents the *Oviductus*'s, and the *Matrixes*; and beſides theſe, the outward Membrane of the *Matrixes*, juſt as it is in its natural Situation, are in this.

a, *a*, Repreſent the two Bags, in which the *Matrixes* are encloſed together with much Water.

Having hitherto ſpoken of the Parts of Generation, I believe it may not be amiſs, or improper, to ſay ſomething of the Generation it ſelf of theſe Fiſh, according to certain Obſervations, which I have made for this purpoſe. And becauſe the Principle of Generation conſiſteth in the Eggs being fruitful, or, as it is commonly ſaid, in their being quickened, with this therefore I ſhall begin my Diſcourſe.

Harveus relateth, that the Eggs of Fiſh are rendred fruitful in the Water of the Females, and quickened by the Seed of the Males, which is ſcattered or ſhed in the ſame Water, which he hath left to us in his 40th Exerciſe. *Vidi ipſemet Piſces Mares Femellam parituram turminationi inſectari, ut Ova recenter poſita Lacte ſuo, ſeu Semine, aſpergerent.* Yet in the Cramp-Fiſh the caſe is otherwiſe, ſince theſe being of the number of Viviparous Animals, that is to ſay, ſuch as lay no Eggs, but bring forth their Young perfectly and compleatly formed, their Eggs muſt needs be rendred fruitful in the Egg-Caſes, within the Body of the Female, as it happeneth out in Quadrupeds, and other Viviparous Animals: So that in order to have the Eggs quickened, it is neceſſary that the Male doth often ſend and ſpirt his Prolifick Seed into the *Matrixes* of the Female, from whence it may be carried, or conveyed, to the *Ovaria*, for the quickening of the Eggs. As to the way then, by which the Seed of the Male is conveyed from the *Matrix* to the *Ovaria*, for the quickening of the Eggs, I believe it is the ſame as it is in other Viviparous Animals: And becauſe this is much controverted by ſome Authors, I ſhall embrace that Opinion, which ſeemeth moſt probable to me, and moſt agreeing with the Obſervations I have already made on that Subject; and this is that of Mr. *Nicholaus Steno*, who aſſerts, that the Seed of the Male being ſpirted into the Cavity of the *Matrix*, either all or part of it inſinuates it ſelf, and penetrates into the Blood; and ſo, according to the certain Rule of Circulation, being brought at laſt to the *Ovaria*, it quickens the Eggs with that Vigour which it hath in it ſelf, ſince ſoon after

Coition, there remaineth not the leaſt Particle of the Seed in the *Matrix* of the Females, as it is evident from the Obſervations of *Harvy*, who for this purpoſe diſſected abundance of Fawn; and I alſo have frequently obſerved it in Dogs, and Rabbets. This Aſſertion was confirmed by Mr. *Gaſpar Bartholinus* in his Book of the *Diaphragma*, contrary to the Opinion of *Regner de Graeff*, who would have it, that in a fruitful Coition, the more ſubtil or finer part of the Seed of the Male, by means of the Tubes, was conveyed to the *Ovaria*, or Egg-Caſes; but that Opinion hath been ſufficiently confuted by the abovemention'd Mr. *Gaſpar*, who made uſe of the Arguments of the ſame *Graeff*, to confute his Opinion: And ſo there is no need of producing any thing more againſt him, but only to repeat, that the Seed cannot be conveyed through the *Oviductus*'s to the *Ovaria*, by reaſon of the Impediment which ariſeth from the little Pipe, or Teat, and from thoſe two or three Valves, which, as I ſaid before, are found in the Cavity of the *Oviductus* of the Cramp-Fiſh, the Maid-Fiſh, and Eagle-Fiſh. The Eggs, at that time when they are quickened, or made fruitful, they are ſpirted or driven by the force of the *Ovaria* into the Cavity of the Tubes, and from thence into the *Matrixes*, where they ſeem to be of a depreſſed Circular Figure, and they are of the colour of Sulphur; as alſo Mr. *Francis Redi* hath obſerved in his Diſſection of the Cramp-Fiſh, which he ſent in a Letter to F. *Athenaſius Kircher*. The natural bigneſs of this is repreſented in the third Figure of the third Table, which ſheweth it to the Life.

In ſome of theſe Eggs, which have already fallen into the *Matrix*, I have obſerved a ſmall Bud, or *Cicatrix*, of the bigneſs of that which is ſeen in the fourth Figure of the third Table, where it is lively repreſented.

This ſmall Bud being exactly of an Oval Figure, about the Center of which there is perceived a white Circle, by the help of a Microſcope, which in the fifth Figure of the third Table (which for the better explaining of it, repreſenteth the ſmall Bud, with all that is within it, bigger than it is in its natural State) is marked with *a*, *a*, *a*, *a*. There is contained within this Circle a certain *Colliquamentum* of a Leaden Colour, which is marked thus *b*, *b*; in which *Colliquamentum* there ſwimmeth the firſt rude Draught of the Animal, marked with *a*, *c*, ſurrounded with a white Stripe or Selvadge, marked with the Letters *d*, *d*. About the biggeſt part of this rude Draught of the Animal, there are placed certain little Bladders of various Figures, and different bigneſs, which are marked with theſe Letters, *e*, *e*, *e*, *e*. The ſmalleſt or fineſt part of the Animal is cut croſs obliquely by a certain little Bag, which is marked with *f*, *f*. The white Circle, which is marked with *a*, *a*, *a*, *a*, is ſurrounded on the out-ſide with a large Swathe, or Bordering, marked *g*, *g*, *g*; which Swathe in ſome places is of a Sulphureous Colour, and in others again of a ſomething darker Colour. That part, which is of the Colour of Sulphur, ſeemeth to be ſomething more ſolid, and the brown part ſeems to be ſomething more liquid. This Swathe is encompaſſed with another Circle of the *Colliquementum*, which is marked *h*, *h*; which Circle in the upper part of it, is ſurrounded with a white Belt or Girdle, marked *i*, *i*. In ſome other Eggs I have obſerved the ſmall Bud hath appeared bigger than that before-mentioned; which ſmall Budd or *Cicatrix*, had its natural Dimenſion juſt as it is repreſented in the firſt Figure of the fourth Table. There was no other difference obſerved in this Bud, or *Cicatrix*, than what relates to the firſt rude Draught of the Animal, and that ſmall Bag, which obliquely cuts croſs the firſt rude Draught of the Animal, as alſo thoſe Bladders which ſurround the biggeſt part of that firſt rude Draught of the Animal, there being none of theſe little Bladders. Theſe differences are better and more eaſily explained by the Figure, than by any Words, and therefore I refer the courteous Reader to the ſame Figure, which is in the fourth Table, and marked with the Number 2, in which

a, *a*, *a*, *a*, Repreſent the white Circle, in which is contained the *Colliquamentum*, *b*, *b*.

c, The firſt rude Draught of the Animal.

d, *d*, The white Bordering, or Selvedges, which go all round the firſt rude Draught of the Animal.

e, *e*, The little Bag, which obliquely cuts a-croſs the fineſt part of the Animal.

f, *f*, The Swathe, which goeth round the Circle *a*, *a*, *a*, *a*.

g, *g*, *g*, *g*, The Circle of the *Colliquamentum*.

h, *h*, *h*, *h*, The white Girdle.

All the Eggs, which are in the *Matrix*, float up and down freely, and not faſtened to any one thing, in a certain Glutinous Humour of a Salt Taſte, and a clear bright colour. This Glutinous Humour is derived from certain long Selvedges of Glandulous Bodies of an Aſhy kind of Colour, which are faſtened to the inward Membrane of the *Matrixes*. Theſe Glandulous Bodies, or little ſmall Glandules, which manifeſtly have their Blood-Veſſels, are, excepting the Colour and Figure, in all reſpects like thoſe ſmall Glandules, which, as I have often obſerved, are ſpread through the outward Superficies of that Membrane, which is called *Chorion*, in Cows, Fawn and Deer; which Glandules are compoſed of abundance of very ſmall Particles, like the ſmalleſt kind of Sand, every one of which ſmall Particles is viſibly furniſhed with its own Blood-Veſſel. Theſe kind of ſmall Glandules, which are ſpread through the outward Superficies of the *Chorion* of Cows, Deer, and Fawns, do anſwer to as many more ſmall Glandulous Bodies that are ſpread about in the inward Superficies of the inward Membrane of the *Matrix*, and theſe are alſo furniſhed with their particular Blood-Veſſels. Theſe ſame Glandules ſpread in the *Chorion* of Cows, have alſo been obſerved by Mr. *Steno*; but he doubted whether there were any other ſuch as theſe in the inward Coat, or Membrane of the *Matrix*, anſwering to thoſe of the *Chorion*, as it is obſerved in the *Cotyledons*; which is a Truth, that ſeemeth to be, by the Obſervations which I have made, to be paſt doubting of. Theſe Glandulous Bodies, or ſmall Glandules, ſerve for the ſame uſe as the *Cotyledons*, and I am apt to believe, that they are nothing elſe but the leſſer ſort of *Cotyledons*. But not to ramble too far from my preſent Subject, that which induced me to believe that thoſe long Rows or Lines of Glandulous Bodies of an Aſhy Colour, which are faſtened to the inward Membrane of the *Matrixes*, were thoſe through which that Humour was ſtrained, in which the Eggs ſwim, and float up and down in the Cavity of the *Matrix*, was firſt my conſidering or reflecting, that there is no other Body through which that kind of Humour can be ſtrained. Secondly, my obſerving, that in thoſe *Matrixes* where there was none of this Humour, there were alſo none of theſe Glandulous Bodies; and in the third place, that in all Cramp-Fiſh, theſe Bodies were not formed after the ſame manner, but in ſome they were bigger, in others leſſer. In the fourth place, that in thoſe *Matrixes*, in which theſe Bodies are leſſer, there is but a little of this Humour, and on the contrary, in thoſe *Matrixes* where theſe Bodies are larger, there is alſo a greater quantity of this Humour. So that if it be true, as I really believe it to be, that where theſe Bodies are wanting, this watery Humour is alſo wanting, and that in proportion as theſe Bodies encreaſe and grow bigger, the Water alſo encreaſeth; it neceſſarily followeth, that thoſe Bodies, or ſmall Glandules are the very Inſtruments through which that Humour being ſtrained or ſeparated from the Blood, is conveyed to the *Matrixes*. There is the very ſame Humour in the *Matrixes*, a little before the Eggs are tranſmitted to the *Oviductus*: There it is, when the Eggs are there, and there it is alſo, after the Cramp-Fiſh hath brought forth her Young; yet with with this difference, that before the Eggs fall into the *Matrixes*, there is but a little Water, and at that time thoſe Bodies, or ſmall Glandules are very ſmall; when the Eggs float up and down in the *Matrixes*, then there is a greater quantity of this Humour, and theſe Glandulous Bodies are bigger. A little after the Birth, this Humour is more copious than ever, and theſe Glandulous Bodies are bigger; but afterwards the Humour decreaſing by little and little, it is at laſt wholly waſted, and vaniſheth away; as alſo theſe ſame Glandulous Bodies by little and little do alſo vaniſh and diſappear, without leaving behind them the leaſt Marks of them: So that it is very evident, that in proportion as the *Fœtus* groweth or encreaſeth, ſo alſo thoſe Bodies encreaſe, and in proportion to the encreaſing of thoſe Bodies, the Humour alſo encreaſeth; and that the ſame Humour alſo is beneficial to the *Fœtus*. Theſe Lines, or Rows of Glandulous Bodies, are repreſented in the third Figure, which is in the fourth Table, in which *a*, *a*, *a*, *a*, ſhew the *Matrix*, when it is opened.

b, *b*, *b*, *b*, *b*, *b*, *c*, *c*, The Bodies, or Glandulous Streaks, which are ſeen faſtened to the inward Superficies of the *Matrix*.

I have obſerved all I have ſaid before, in the Falcon-Fiſh, the Eagle-Fiſh, and Maid-Fiſh, which Fiſh I have had the fortune to ſee, when their Young were perfectly formed, and alſo ſtill encloſed in the *Matrixes*; and becauſe in theſe Fiſh, the Structure of the Parts of Generation, ſeem to me to be very like, and even the very ſame as they are in the Cramp-Fiſh, I think it may not be very remote from, or inconſiſtent with our preſent Subject to relate here, what I have in particular obſerved in relation to them. Whilſt (on the 14th of *March* 1676, and for ſome Days following) I was with the Court at *Leghorne*, by the Civility of Mr. *Francis Redi*, I had a great occaſion, together with him, to obſerve many Fiſhes, and thoſe of a different kind, at his Houſe, where that moſt Famous Naturaliſt Mr. *Oliver James* was ſometime preſent alſo, and Mr. *Chriſtopher Bartholin*, the Son of the moſt Learned and Famous Anatomiſt *Thomas Bartholin*. Among others, I had in my Hands a very large Maid-Fiſh, whoſe Belly was very much ſwelled, or puffed up; whence I having a great Curioſity to ſee what there was ſhut up or encloſed in the inſide of it, laying all other things aſide, I ordered the Matters ſo, that that was the firſt Fiſh which was diſſected. I opened the *Abdomen* of it, and within I found what I had before imagined, and earneſtly deſired; that is to ſay, that the Bags of the *Oviductus*'s or *Matrixes*, did contain within their Cavities, the young Maid-Fiſh, which were perfectly formed; and I was ſenſible of it, or perceived it, before I had ript up the *Matrixes*, ſince their Figure appeared outwardly. I diſſected the *Matrixes* according to their Length, and I found that in each of them there was a *Fœtus* of a conſiderable bigneſs. That *Fœtus*, which was in the *Matrix* of the Right Side, had its Head turned back towards the Head of the Mother of it, and his Tail enter'd into the *Matrix* on the Left Hand or Side. The *Fœtus*, which was in the *Matrix* on the Left Hand, turned its Head towards the Tail of its Mother, and the Tail of it paſſing through the *Matrix*, towards the Head of the Mother, when it came to that *Papilla*, or little Teat, by means of which the Tubes diſcharge themſelves into the *Matrixes*, the Tail being hinder'd by this ſaid Teat, or little Pipe, from paſſing any farther, turned back again. Theſe *Fœtus*'s being ſhut up within the *Matrixes*, had no Connexion at all with the ſaid *Matrixes*, but freely floated up and down on all ſides, in a certain Fluid, which was clear and bright, and of a Saltiſh Taſte, like that which, as I have ſaid, is found in the *Matrixes* of Cramp-Fiſh. And here by the way, I muſt needs advertiſe you, how very much thoſe are deceived and miſtaken, who maintain, that there is no Blood generated or made in the *Fœtus*, but that the ſame Blood, in the very Form it is, is conveyed from the Mother to the *Fœtus*:

for it is impoſſible to maintain, that in theſe ſort of *Fœtus*'s which have no Connexion at all with the *Matrix* of the Mother, the Blood can paſs from the ſame Mother into the *Fœtus*, in the form and appearance of pure perfect Blood; nor doth it ſignify any thing here to ſay, as many are uſed to do, that in thoſe Animals which lay Eggs, the caſe is quite otherwiſe than it is in thoſe which bring forth their Young Ones alive; ſince firſt it is now clear and evident, that all Animals, and even Man himſelf, proceed from an Egg; than in thoſe Animals, which are called Viviparous, the Blood paſſeth not from the Mother into the *Fœtus*, under the form of Blood, as I ſhall demonſtrate elſewhere, if God pleaſe. It is very true, that there is a certain Fluid, which is ſeparated from the Mother's Blood, by means of the *Cotyledons*, or *Placenta*; which ſaid Fluid afterwards paſſeth through the Umbilical or Navel-Veſſels, for the nouriſhment of the *Fœtus*; which hath been hinted by Mr. *Gaſpar Bartholini*, in his Letter of the Hiſtory of Generation, and before him by Mr. *Steno*. But let us return to our Subject. In that Fluid, or Humour, in which the *Fœtus*'s ſwimmed, there alſo ſwimmed up and down ſeveral Excrements of the Subſtance and Colour of Mud, which to the Tongue appeared inſipid. Having opened the Stomach of the ſaid *Fœtus*'s, I found that it was full of the ſame kind of Excrements, as thoſe were which ſwimmed up and down in the foreſaid Humour, or Water; and I alſo found ſome of the ſame kind of Excrements in the *Oeſophagus*, or to ſpeak more properly, in the Jaws, and in the Mouth. The Egg, with which the *Fœtus* was nouriſhed, hung down partly out of the *Abdomen* of the ſaid *Fœtus*, in the form of a Pear; from thence growing ſmall like a Pipe or Conduit of the bigneſs of the Quill of a Hen, which formed the Stalk of the Pear, pierced through the Muſcles of the *Abdomen*, and entered into the Cavity of the ſaid *Abdomen*, where enlarging it ſelf again by little and little, as it were, into another Pear much bigger than that which hung dangling down on the outſide, it faſtened it ſelf to the Inteſtin, and at a Hole which was manifeſt enough, it diſcharg'd the Matter, which it had within it ſelf, into the ſaid Inteſtin; which ſaid Inteſtin was full, partly with this yellow Matter or Subſtance which cometh from the Egg, and partly with another Subſtance of the ſame kind with that, which, as I have ſaid before, floated up and down in the *Amnion*, and was found in the Stomach, the Jaws and Mouth of the *Fœtus*. From theſe Excrements, which are found in ſeveral different places, one may give a good gueſs, or form a probable Conjecture, that the *Fœtus*, beſides that Nouriſhment which it receiveth from the Inteſtins, receiveth alſo Nouriſhment at the Mouth, contrary to their Opinion, who aſſert, that the *Fœtus* is nouriſhed only by the Naval Veſſels, or Inteſtins. In confirmation of which, Mr. *Francis Redi* told me, that he having diſſected a Wild ſow, *A. D.* 1666. which was big with four Young-Ones, he obſerved, that in the *Amnio's* there was a whitiſh Liquor like the White of an Egg, in which there were ſwimming abundance of little yellow Globes, of the conſiſtence of Excrements or Dung, and about the bigneſs of Vetches. Having opened the Stomach of the young Pigs, which floated up and down in the Liquor of the *Amnio*'s, he found that their Stomach was very full, not only of that white Liquor, but alſo of thoſe ſmall yellow Globes, with which the Guts or Inteſtines were alſo filled; but theſe in the Inteſtins appeared to be of a more fiery Colour; and this is what I have frequently obſerved in Cows, Deer, and Fawns. It is a thing worthy of your Obſervation, that theſe young Pigs, as the forementíon'd Mr. *Francis Redi* related to me, beſides their being wrapped and guarded, as abundance of other Animals are alſo, in three Membranes, the *Chorion*, the *Amnio*'s, and the *Allantoides*, every particular young Pig was alſo covered with a fourth Membrane, as with a very fine white Shift, which coming cloſe to all the Parts of their hairy Body, covered even Legs and Feet too, and even Tail alſo. That Shift notwithſtanding left a free and open Paſſage for the Mouth, Eyes, Noſtrils, Navel, and that where the *Inteſtinum Rectum* terminates, that is, the *Podex*. But I ſhall ſay more of this Particular, if it pleaſe God, at a more convenient time.

Having now deſcribed the Parts which belong to Generation, we muſt now diſcourſe of the Time and Seaſon, in which the Cramp-Fiſh bring forth. All Authors agree in this, that they bring forth about the *Æquinox*. Thus *Ariſtotle*, in the Eleventh of the Sixth Book of his Hiſtory of Animals, and *Pliny* in his Ninth Book and Fiftieth Chapter. Yet *Ariſtotle* and *Pliny* do not altogether agree; for *Ariſtotle* means the Autumnal *Equinox*, αἱ δὲ νάρκαι περὶ τὸ φθινοπώρον;

ὀπώρουν; that is, the Cramp-Fiſh bring forth about Autumn. And *Pliny* doth not any way particularize, whether it be the Spring-*Equinox*, or that of the Autumn. By my own Obſervations I find, that the Cramp-Fiſh bring forth their Young about the Spring *Equinox*, as I ſhall here ſhew. One may make a better Apology for *Pliny*, who doth not determine in which *Equinox* it is that they bring forth their Young Ones, ſince we may queſtion it, whether he did not ſpeak of the Spring *Equinox*; but there is no defending of *Ariſtotle*, nor can any one alledge in his defence, that the Cramp-Fiſh bring forth their Young twice in one Year, that is to ſay, in both *Equinoxes*; becauſe the ſame *Ariſtotle*, in the Eleventh Chapter of the Sixth Book of the Hiſtory of Animals, hath left us this in his writing ἐπικυΐσκεται δὲ τὰ σελάχη καὶ κυεοτης πλείους μῆνας ἕξ; that is, that the Cartilaginous Fiſh are big, and bear their *Fœtus* ſix Months at moſt. Of the Truth of which I ſhall preſently ſay ſomething; whence it is evident, that according to the Opinion of *Ariſtotle* alſo, they do not bring forth their Young but once a Year. From the following Obſervations I conjecture, that they bring forth about the Spring *Equinox*: For the 24th of *Febr.* 1676, I with Mr. *Oliver James* diſſected a Cramp-Fiſh, in which I obſerved, that in one of the *Matrixes* there were ſwimming eight Eggs, and in the other ſix. The 26th of the ſame Month I diſſected four of them, three of which had in one of the *Matrixes* five Eggs, and in the other, three in each; the fourth was big with ten Eggs, ſix of which floated up and down in one *Matrix*, and four in the other. On the 4th of *March* in the ſame Year, I diſſected two Cramp-Fiſh, each of which had ſix Eggs in one *Matrix*, and four in the other. I found alſo in the *Ovaria* of all the abovemention'd Cramp-Fiſh, always as many *Calixes*, or Cups, as there were Eggs in the *Matrixes*, and every Cup fitted, or reſpected the Eggs of each *Matrix*. Beſides, the 6th of *April*, in two Cramp-Fiſh which I diſſected, I obſerved that the *Matrixes* contained no Eggs at all in them, but ſtill they were full of that white Humour of which I have diſcourſed before; and I obſerved, that in the *Ovaria* there were faſtened eight Cups, entire and whole, and pretty; but ſomething ſhrunk up and ſhrivelled: Which ſhew, by what I have ſaid before, that theſe Cramp-Fiſh had brought forth their Young a little before; and I have frequently obſerved the ſame thing in ſeveral other Cramp-Fiſh, which were diſſected in the ſame Month. There are many other Obſervations, which I made 1677 and 1678, which agree perfectly well with theſe. And tho' in the ſpace of the three forementioned Years, I diſſected a vaſt number of Cramp-Fiſh, I never yet had the fortune to open one Cramp-Fiſh, which had her Young Ones perfectly formed in their *Matrixes*, and juſt ready to be brought forth; and yet I have uſed all the diligence and attention poſſible to gain this point, ſince I had an extraordinary curioſity and deſire to ſee and obſerve at leaſt one Cramp-Fiſh big with their Young Ones in their *Matrixes*. Nevertheleſs, I having obſerved that many Cramp-Fiſh, which were diſſected in *February* and *March*, were then big with Eggs in their *Matrixes*, and that many others which were diſſected in *April*, were eaſed of their Burthen, by Conjectures I am apt to believe, that the Seaſon of their bringing forth their Young Ones, is within theſe three Months, *February*, *March* and *April*, and thus a little before or a little after the Spring *Equinox*. And becauſe I have met with the ſame Obſervations in other Cartilaginous Flat-Fiſh, therefore I ſhould be apt to believe, yet ſtill by way of conjecture, that time is aſſigned for all of them to bring forth their Young.

By theſe Conjectures, let them ſay what they will, one might infer how erroneouſly *Ariſtotle* hath writ about the time of their being big, and the continuance of the ſame time, who affirmeth it is no more than ſix Months at moſt, ſince I have probably ſhewn, that the whole Formation of the *Fœtus*'s is finiſhed about the Months of *February*, *March* and *April*. If I ſhall ever have the good fortune to make any Obſervations more exact than theſe, as I hope I may, then I ſhall be able to diſcourſe on this Subject with greater Courage and Freedom.

Having now finiſhed the Parts of Generation belonging to Females, with every thing which belongeth to them, I muſt now deſcribe thoſe alſo which in my opinion belong to the Male. In the mean while, there are ſome Male Cramp-Fiſh, which have their Inſtruments of Generation in the very ſame place where the Females have theirs; which are certain Bodies, or to ſpeak more properly, white Conduits, winding in and out in a ſtrait Line, a-long the Back, to which they are ſtrongly faſtened; which beginning near the *Podex* about the bigneſs of a Hen's Quill, grow leſſer by little and little, and contract themſelves into more artificial Windings, till at laſt they become as ſmall as one ſingle Thred. They are at laſt united or joined to two Glandulous Bodies, which are faſtened to the two Lobes of the Liver, in the very ſame place, where the *Ovaria* of the Females are placed. Theſe Bodies, or rather Conduits, are lively repreſented in the fourth Figure, which is in the fourth Table, in which

a, *a*, Shew the Teſticles.

b, *b*, *b*, *b*, The Spermatick Veſſels.

c, The Teat, or ſmall Pipe, by means of which the Spermatick Veſſels diſcharge themſelves outwardly.

I at firſt believed, that theſe Bodies were the *Tubæ Fallopianæ*, or *Oviductus*; and ſo much the more, becauſe I had obſerved, that the Tubes alſo, in many other Fiſh, and eſpecially in Frogs and Eagle-Fiſh, had many Rounds or Windings; and I was always more confirmed in this my Opinion, particularly ſince Mr. *James* had related to me, that he had obſerved the very ſame Structure in the *Salamandres*: But at laſt, being not fully ſatisfied or confirmed in this my Opinion, I reſolved and propoſed to examine this Matter or Subject more nicely, and to try whether they were truly what I took them to be; and therefore I uſed all diligence and attention imaginable in obſerving and examining of them; after which I was forced to alter my Opinion, and to doubt, ſince they could not be the Veſſels of Generation which belong'd to the Females, as being very different from them, whether they were not thoſe of the Male, being like thoſe in the Males of other Animals. The Motives which diſpoſed me to change my Opinion, were theſe here following.

The Firſt was, my conſidering, that if thoſe Bodies were the Veſſels of Generation which belong to Females, we muſt needs have confeſſed, that under the ſame Species, and in the very ſame Kind, two Subjects might have, or actually had their Organs of Generation formed after different manners, without being able to comprehend why, or for what end it was ſo; which ſeemed to me very abſurd, ſince hitherto, in all Bodies of the ſame kind, in the ſame Species, their Organs, as it hath been obſerved, have been formed after the very ſame manner, and with the ſame Circumſtances, unleſs they had been changed or ſpoiled by ſome Sickneſs, and particularly that this was no accidental difference, nor in one Subject only, but was obſerved in many, which in all other things agreed with each other, except in the Parts of Generation.

The ſecond Motive, was my conſidering, that granting theſe Bodies were the Inſtruments of Generation which belonged to Females, tho' they very much reſembled theſe kind of Inſtruments in the Females of ſeveral Species's, in their winding up and down; yet they differ'd much from them in many other things: And firſt, as to their Figure, ſeeing that theſe being very ſmall in the beginning, by little and little grew bigger; and on the contrary, in other Females, they are big at firſt, and afterwards grow ſmaller by little and little; or elſe being ſomething bigger in their beginning, they afterwards retain the ſame bigneſs all along, as in Frogs, or in the Eagle-Fiſh. Secondly, As to their Connexion; for theſe were ſtrongly faſten'd to the Back of the Animal, by means of a certain Membrane, which making a kind of a Sheath for them, held them ſo faſt, that they could not be ſtirred from the Place which was deſigned for them; and moreover they kept them faſtened after ſuch a manner, that they could not poſſibly, or very difficultly be ſo much as dilated: Whereas in other Cramp-Fiſh, which are really Females, they are faſtened to the Back large wiſe, by means of a Ligament, and in ſuch a manner, that they may be dilated, as much as there is occaſion for it.

The Third Motive I had, was my conſidering, that allowing they were the Veſſels, or Organs of Generation in Females, it was impoſſible for them to take the Eggs within themſelves, eſpecially ſince in that part, which reſpects the *Ovaria*, they are ſo very ſmall, that they would not be capable of receiving within them the leaſt Grain of the ſmalleſt Sand, much leſs an Egg as big as the Yelk of a Hen's Egg.

The fourth Motive, was my conſidering and reflecting on the great reſemblance, which theſe Veſſels have with the Organs of Generation,

neration, in the Males of other Animals, as the Cock, the Sea-Crab, and Lobſter: For as to the Lobſter, the Spermatick Veſſels of the Male are nothing elſe, but two Pipes, ſhut up within certain Membranes, which being extraordinary ſmall in their beginning, do form a vaſt number of ſmall Rounds, and growing afterwards big by little and little, make bigger or larger Rounds; and at laſt eight Fingers breadth near the Egreſs, or Paſſage outward, as Mr. *Willis* very well obſerveth, being formed like the ***Epididymi***, they diſcharge or empty themſelves at two Holes, which are in their hindermoſt Legs. It is very true, that *Willis* was much miſtaken, in affirming, that theſe Holes are placed, and opened in the two laſt Legs but one; ſince they are really opened and ſeated in the firſt Articulation, even of the laſt Legs, or hindermoſt, and not in the laſt but one, which one may ſee by experience, as I my ſelf, with the Teſtimony of my moſt Judicious Friends, have frequently obſerved, not only in the ſame Sea-Lobſters, but even in Creviſe, or ſweet-water Crabs; and laſt of all, I lately obſerved it (with Mr. *Francis Redi*) in the large Shrimp of *Rondeletius*. At theſe Holes, which are ſeated, as I ſaid, in the laſt Legs, there appear outwardly two long Teats, which are bor'd through in their Extremities, and are endued with a moſt delicate and fine Senſe, ſince being gently touched with the Point of a Knife, they make the Animal wriggle and toſs himſelf up and down very briskly. Through theſe Teats, or ſmall Pipes, it is, that the Seed paſſeth out, and is ſpirted there where the Animal pleaſeth, ſince the ſame Animal draweth in or letteth out thoſe very Teats as he pleaſeth. The Structure and outward Paſſage of thoſe Veſſels are the ſame in the Crabs as they are in the Lobſters, except only this, that thoſe of the Crabs are ſomething more enwrapped up than thoſe in the Lobſters, and are as it were gathered up into a heap. And to the end, that the Structure of theſe Veſſels, which appear as well in the Crab as in the Lobſter, may be the better underſtood, I ſhall here produce the two Figures, which are in the fourth Table, marked with the Numbers 5 and 6, the 5th of which repreſents thoſe of the Lobſter; and in this

A, Sheweth the extraordinary ſmall beginning of the Spermatick Veſſels.

B, The very ſame Spermatick Veſſels, as they grow bigger by little and little.

C, The ſame Spermatick Veſſels, as they are formed like *Epididymi*.

D, The open Hole in the firſt Joint or Articulation of the laſt Leg of the Lobſter, through which the Spermatick Veſſel diſchargeth it ſelf.

E, *E*, The laſt Leg of the Lobſter, with all its Articulations.

The Sixth repreſenteth thoſe of the Crab; and in this Figure

F, Sheweth thoſe Parts of the Spermatick Veſſels of the Crab, which by forming ſeveral Rounds, are gathered together into a Knob or Ball, whoſe very fine beginning is hid under the biggeſt ſort of Rounds.

G, The Rounds which the Spermatick Veſſels make without the Ball, growing ſmaller by little and little.

H, The ſmalleſt part of the Spermatick Veſſels, which is equal to the beginning of the ſame Veſſels.

i, *i*, The Spermatick Veſſels, which growing bigger by little and little, do form ſeveral Rounds.

L, The Spermatick Veſſels, which growing ſmall again, do empty or diſcharge themſelves, by means of the little Pipe or Teat *M*.

N, *N*, The laſt Leg of the Crab, with all its Articulations.

In the Cock they in all reſpects reſemble thoſe of the Cramp-Fiſh, ſince beginning from the Teſticles, with a very ſmall Extremity, they make ſeveral Rounds or Compaſſes, and growing bigger by little and little, they ſtill encreaſe, and enlarge their Rounds, till they come to diſcharge or empty themſelves, according as I before ſaid it was in the Cramp Fiſh.

The Fifth Motive, was my conſidering, that granting theſe were the Organs of Generation which belonged to the Females, Nature could have no other end or deſign in forming ſo many Rounds, and in lengthening the Veſſels ſo much, but the rendring of them capable of being dilated ſo far, as to retain the Eggs and *Fœtus*'s:

and to the end that the great Length of them might be changed into Largeneſs; which End methinks can no ways agree or be ſuited to theſe Veſſels, ſince, as I ſaid before, they are encloſed, as it were, in a Sheath, and ſo ſtrongly faſtened to the Back, that they cannot poſſibly be any ways dilated.

The ſixth Motive, was my conſidering, that allowing the abovementioned End had agreed with them, with much more reaſon there muſt needs have been the very ſame Structure in the Cramp-Fiſh, which are much leſs, in which, beſides the Dilation, there muſt have been an encreaſing of the ſame Veſſels, in proportion to the encreaſing of the Body: But there is not only any ſuch thing, but, as I ſaid before, even in the leaſt of them, thoſe ſame Organs of Generation are extraordinary ſtrait, and are ſo far from forming any Round, that they are no bigger or larger than a little Cord of ſewing Thred. Theſe and other Motives, which I expreſly omit, made me, as I have already ſaid, alter my Opinion, and to hold it as a certain Truth, that theſe Veſſels, are nothing elſe but the Spermatick Veſſels which belong to the Male; and that thoſe two Glandulous Bodies, which are faſten'd to the Lobes of the Liver, are nothing but the Teſticles themſelves. And here we muſt ſuppoſe how much *Ariſtotle* was miſtaken, when in the thirteenth Chapter of the ſecond Book of his Hiſtory of Animals, he left us theſe Words written: ᾽Αυχενὰ δὲ ȣδεὶς ἔχει ἰχθυς ὢ δὲ κῶλον ȣθὲν ὢ δ᾽ ὄρχεις ᾽ολως ὢτε εντος ὢτ᾽ ἐκτος: That is, that no Fiſh had any Neck, or any Inteſtin, and had no Teſticles either within or without the Body: For as we have already ſeen, the Males of the Cramp-Fiſh are ſo far from being deprived of them, that they have them, and very viſibly too. Abundance of other Male Fiſh, of ſeveral Kinds, if not all, have alſo their Teſticles ſome bigger, ſome leſſer, according to their different Species, as any one may plainly ſee; and theſe Teſticles are nothing elſe but thoſe Bodies which are encloſed or ſhut up in the Cavity of the *Abdomen* of the ſame Fiſhes, and which by our Fiſhermem are called the Soft Roe of Fiſhes. Hence thoſe Fiſhes which have theſe kind of Bodies, are called Soft-roed Fiſhes, but in reality this Roe is nothing but the Teſticles, which contain within them abundance of white Subſtance, which much reſembleth Milk; and this is that which the ſame Fiſh, at that time

when

when they rub againſt the Females, ſpirt forth from their Body, through a Hole, which is on one ſide of the Hole of the *Podex*. But let us return to our Subject. Thoſe Veſſels, which have been deſcribed before, being joined by a long large Teat, do open into the very ſame place into which the *Matrixes* of the Females do alſo open; and I am apt to believe that this great long Teat ſerveth for a *Membrum Genitale:* And ſo much for this point, let us now paſs on to the Deſcription of the Vital Parts. The Heart of the Cramp-Fiſh is not much unlike that of other Fiſh, as it is repreſented in the firſt Figure, which is in the fifth Table, with one Auricle only, with Veſſels like thoſe of the Heart in other Fiſh; and it is ſpread all o'er here and there with abundance of very pretty Ramifications of the Coronary Veſſels. The Heart being ſeparated and taken out of the Body of the Cramp-Fiſh, and all the Blood-Veſſels torn from it, doth commonly continue its Motion and Palpitation for the ſpace of ſeven, eight or nine hours together (as Mr. *Francis Redi* hath alſo obſerved in his Deſcription of the Cramp-Fiſh.) The reſt of the Body, even when the Heart is taken out, ſtill ſheweth for three Hours together moſt evident Signs of Motion and Senſe, the Tail being the laſt Part which is deprived of the ſaid Motion or Senſe; which confirmeth the truth of that which the ſaid Mr. *Francis Redi* hath writ of it. Mr. *Boyle* found out by Experiment, that the ſame thing happens out alſo in Frogs, which even after their Heart is torn from them, do uſually live, and skip up and down in the Water for ſome Hours. And it is now very well known that all Inſects have the ſame Property; as alſo by the Obſervations of Mr. *Francis Redi*, that the Head of a Viper being ſeparated from the Trunk of the Body, doth not uſually move for ſome time, but alſo bite, and empoiſon ſo far, as to endanger ones Life. That Motion which the Heart maketh, when ſtript of all the Blood-Veſſels, and torn and cut into ſeveral Pieces, is an Argument againſt thoſe, who will have it, that the Motion of the Muſcles is performed by the flowing of the Blood into the ſame Muſcles, ſince it is very evident, that the Heart, which is nothing elſe but a Muſcle, may move it ſelf, without the Concurrence or Afflux of any Blood to it from any other Part. The Lungs in the Cramp-Fiſh are, generally ſpeaking, the ſame as they are in other Fiſhes, and they are commonly called the Gills, which in the

Cramp-Fiſh have ten Holes on the Inſide of the Mouth; that is, five on each ſide, correſponding to ten other Holes of a hooked Figure, and turning their Ends towards the *Podex*, being ſeated in the Plain of the ſame *Podex*. The Water, which entreth in at the Mouth of the Cramp-Fiſh, goeth out again at theſe ten inward Holes, and after it hath waſhed and well cleanſed the Bodies of the Gills, it runneth out through thoſe other ten outward hooked Holes, which are in the Plain of the *Podex*.

And here one may ſtart a curious Queſtion, which is this: Why Fiſh have the true outward Superficies of their Lungs quite contrary to other Animals, that is, convex, when other Animals have it hollow? In anſwer to the Queſtion here propoſed, we muſt firſt conſider, that in order to preſerve the inward Fluid (that is, the Blood) it was neceſſary, that beſides the other Excrements, which are exterminated or evaporated from the different Parts of the Body, there ſhould be ſeparated another from that, which ſhould not be gathered together in any one place for a certain time, but ſhould be continually mixed with the outward Fluid, that is, with the Air, in ſuch Animals as live in the Air, and with the Water, in ſuch Animals as live in the Water, otherwiſe the remaining part of the inward Fluid would be ſpoiled and corrupted; and beſides, it was neceſſary that a Supply of freſh Particles ſhould be conveyed into the Blood, without which the Blood would decay. This ſo neceſſary admiſſion of freſh Particles is conveyed through the Conduit through which the Food or Nouriſhment paſſeth. But Nature hath appointed the Skin for the ſeparating of the foreſaid Excrement from the Blood, having in that placed the narroweſt part of the Blood-Veſſels, in order to carry therewith the Blood, that Subſtance or Matter which was diſpoſed to paſs through the Pores of thoſe narrow Veſſels or Paſſages. But becauſe there was more of that Humour, which ought to be ſeparated from the inward Fluid, that is, the Blood, than could be evaporated or ſeparated through all thoſe narrow Veſſels which are ſpread o'er all the Skin; for this reaſon Nature hath reduced and gathered into one Body many of the narroweſt of the Blood-Veſſels, of the ſame ſort as thoſe which are ſpread through all the Skin, and joined them together by the means of many Membranes, and ſo fitted them one with another, that they are always expoſed to the outward Fluid, whether they be reverſed outwards, as in Fiſhes, or withdrawn inwards, as in ſuch Animals as live on Land, and in ſuch as inhabit the Air; and to this kind of Collection or Heaps of narrow Veſſels or Pipes, Authors have given the Name of Lungs. In the mean while there is ſeparated in the Lungs, an Excrement from the inward Fluid (that is, the Blood) like that which is expelled through the Pores of the whole Body; which ſaid Excrement is nothing elſe but a Collection of thoſe inviſible Particles, which are ſeparated from the inward Fluid; which Particles whilſt they paſs together with the whole inward Fluid through thoſe narrow ſmall Pipes or Veins, of which the Lungs are chiefly compoſed; they are conveyed from the ſame inward Fluid through the Pores of the ſame narrow Parts, into the outward Fluid, by the aſſiſtance of ſome Matter, or any other Motion. This ſame Excrement, which is ſeparated in ſuch a Form, and conveyed from one Fluid to another, I call the Excrement of the Lungs, and there are two ſorts of it, one which is thicker, and more watery, another which is thinner, more dilated, and more airy. Each of theſe is fitted and proportion'd according to the different Individuals in which it is ſeparated: For in thoſe Animals, in which the Excrement, which is ſeparated through all the Pores of the Skin, is more thick and more watery, the Excrement of the Lungs is alſo more thick and more watery, than in thoſe, in whom this kind of Excrement, which paſſeth through the Pores of the Skin, is more dilated and more airy. In ſhort, in the very ſame individual Perſon, the Excrement which is ſeparated in the Lungs, and that which paſſeth through the Pores of the Skin, are very like, and even the very ſame, as it evidently appeareth by Experience. Whence, methinks, we may conclude, that what I ſaid before is really true, that is, that thoſe narrow Parts of the Blood-Veſſel, or Capillarys, which are in the Skin, and in the Lungs, are of the ſame kind, and that thoſe which are in the Lungs, are there joined together for no other end, but to ſupply and promote the Separation of that Excrement, which ought to have been carried off through the Pores of the Skin, which were not ſufficient for that purpoſe. In the mean while, becauſe the thicker and more watery Excrement is more difficultly diffuſed in the outward Fluid, ſince the ſame quantity of moving Particles, which move the outward Fluid, are not ſufficient or ſtrong enough to move that Excrement; therefore this ſame Excrement remaineth faſtened to the outward Superficies of the Lungs. So likewiſe, becauſe the thinner, more dilated, and more airy Excrement, is more eaſily diffuſed or ſcattered in the outward Fluid, ſince the ſame quantity of moving Particles equally moveth the outward Fluid and Excrement too; hence it is, that this is more eaſily ſeparated from the outward Superficies of the ſame Lungs. This Excrement is ſeparated and carried off from the outward Superficies of the Lungs, two ſeveral ways. The firſt is, when a freſh Excrement ſucceeding, driveth away that which was faſten'd there before; and this happeneth in the Lungs of all Animals whatſoever, during the time that being encloſed within the Egg, they ſwim and float up and down in the watery Humour. The ſecond manner or way after which the Excrements are ſeparated and removed from the Superficies of the Lungs, is this: When the outward Fluid being impregnated with the Excrements of the Lungs which it hath touched, is changed; and thus it is in all Animals, when once they are got out of their Egg. But this outward Fluid, which ſerveth to carry off the Excrement from the Lungs, varieth according to the different Individuals which it is to ſerve: For as ſome Individuals live in the Air, and ſome in the Water; ſo alſo the outward Fluid, which ſerveth to carry off the Excrement from the Lungs of theſe Animals, is either watery or airy; and the watery Fluid ſerveth for thoſe Creatures which live in the Water, and the airy Fluid for ſuch as live in the Air, both ſerving for the ſame end, tho' after a different manner: For the airy outward Fluid, at the very ſame way by which it paſſeth to touch the outward Superficies of the Lungs, it is ſent out or reflected back again; that is, it is recipocrated: Whereas the watery Fluid paſſeth out through a way that is altogether different from that, through which it was admitted to touch, or raze on the outward Superficies of the Lungs. The reaſon why theſe two Fluids operate after ſo different a manner, is this, that the Fluid which is ſeparated in the Lungs of different Animals, is alſo different: For in that very place from whence there cometh out a clammy and viſcous Fluid, as in the Lungs of Fiſhes, it is required, or is neceſſary, that the Fluid, which is to waſh the Superficies, ſhould there paſs over it with ſome force or violence, and conſequently that the

Superficies which it waſheth be of a Convex Figure: For if it ſhould be otherwiſe, that is, concave or hollow, the Fluid could never paſs with that force as is neceſſary for the doing of its Office, ſince it would be reflected back; that is to ſay, that it would go in and out at the ſame way; whence the Excrement would not be ſeparated from the Lungs, but would be even beat back again, and fixed in the Concavity of the ſame Lungs. Whereas on the other ſide, where there cometh out a more airy and more vaporous Excrement, it is neceſſary that the outward Fluid do not paſs with that foreſaid violence in touching the Superficies of the Lungs, but that it be reflected back, and conſequently, that the Superficies, whoſe Excrement it is to carry off, be hollow; for ſhould it be of a Convex Figure, the outward Fluid could not be reflected back, but would paſs with violence; that is to ſay, that it would enter in at one place in order to touch the Superficies of the Lungs, and would go out at another; whence this Inconvenience would follow, that either too great a quantity of theſe Particles would be ſeparated from the Blood by the exceſſive Heat of the outward Fluid, or none at all through the exceſſive Cold of the ſame outward Fluid. And from hence is drawn a moſt evident Demonſtration of the Wiſdom and Providence of the Sovereign Artificer; ſince in every Animal he hath diſpoſed and proportion'd the Organs of Motion, and Figure of the Veſſels, according to the Nature of the Fluids of the ſame Animals: For in thoſe Animals whoſe Excrements are thicker, the outward Superficies of the Lungs, which is contiguous to the outward Fluid, is of a Convex Figure; and there he hath ſo adjuſted and fitted the ſaid Organs or Inſtruments after ſuch a manner, that they are continually driving ſome freſh Portion of the outward Fluid to the Superficies, which by the conſtant renewing of the ſame outward Fluid, is waſhed as by a River, and by that means, the Excrement which was gathered all about the ſmall Convex Pipes of the Lungs, is clearly carried off: But in other Animals, whoſe Excrement is thinner, and more dilated, the Divine Artificer hath made the Superficies of the Lungs, which toucheth on the outward Fluid, hollow, and fitted them with fit Inſtruments to recipocrate the Motion of the outward Fluid, by means of which Inſtruments the ſaid Animals may expel from their Lungs the outward Fluid impregnated or charged with Excrements, and drive or force into the Lungs another freſh Supply of the ſame outward Fluid, not ſo full of them, nor yet altogether free from the ſaid Excrement: I ſay, not altogether free, becauſe that freſh Supply of the outward Fluid, in paſſing through the Mouth and the *Aſpera Arteria* towards the Lungs, cannot avoid being mixed in ſome degree with thoſe very Excrements, which are driven out from the ſame Lungs: And beſides, in Inſpiration there entreth again ſome ſmall Portion of that ſame corrupted Air, which by the precedent Expiration was driven forth, and flutter'd, and was whirled, as one may ſay, about the Atmoſphere of the Mouth.

And what is more, the ſame Divine Artificer hath formed the hollow Lungs with a different kind of Structure, according to the difference of Animals. Now, to deſcribe theſe different Structures of the Lungs, would be here ſuperfluous or needleſs, and perhaps this is a Work already done by ſome other Perſons: Therefore omitting that, I ſhall go on, and deſcribe the remaining Parts of the Cramp-Fiſh; and having deſcribed all of them, but the Head, and the Parts which are contained in the Head, from theſe I ſhall renew or recontinue the Thread of my Diſcourſe.

The Brain of the Cramp-Fiſh, as in all other Animals, is cover'd with two ſmall Coats or Membranes, one whereof is called the *Dura Mater*, the other the *Pia Mater*; and the *Dura Mater*, which ſurroundeth the Brain on the outſide, hath a kind of Cartilaginous Solidity, or Subſtance, with the very ſame manner as I have frequently obſerved it in the *Pericranium* of a Lamprey: It is not faſtened in any place outwardly, or to the Vault of the *Cranium* which is above it; but about the Baſis of the *Cerebellum*, it is ſo ſtrongly faſtened to the Bones, that it ſeemeth to be one and the ſame Subſtance, or all of a piece; but inwardly, that is, in the Concavity of it, it is ſo free and looſe, that it is no where at all faſtened to the *Pia Mater* by the means of any Veſſels or Fibres; nor doth it touch it in any one place, unleſs it be in that, where it correſponds with the Baſis of the *Cranium*, and here the whole Bulk of the Brain is encloſed. On the Inſide of the Cavity of the *Dura Mater*, there is encloſed a certain viſcous Humour, in which (as one may ſay) the whole Bulk or Subſtance of the Brain, which is covered with the *Pia Mater*, ſwimmeth, of which *Pia Mater* I ſay nothing here, becauſe it is juſt the ſame as it is in all other Animals.

mals. The Brain, as to it ſelf, is compoſed in a manner of ſo many little Knobs, which are ranged after the manner here following, for the explaining of which, I ſhall firſt deſcribe the Superficies, or upper part of it; and afterwards the lower part, that is, the Baſis.

In the Fore-part of the Brain, there is a certain Knob, which is pretty big, and round, behind which there are alſo two other Knobs of a very irregular Figure, both which Knobs together are much leſſer than the forementioned Knob. Behind this Pair of Knobs there is alſo another Pair, which are longiſh, and alſo of an irregular Figure. Theſe two longiſh Knobs, taken together, are twice bigger and more than the two foreſaid Knobs. In the Space which is betwixt theſe two Pair of Knobs, there is in the upper part a little Vally, in which, in a certain manner, there reposeth a certain Body, like the *Cerebellum* of Four-footed Beaſts, as to its outward Figure; which ſaid Body is faſtened to the Baſis of the Brain by two Lengthenings, like two Legs, here and there, juſt after the ſame manner as the *Cerebellum* is faſtened to that Body, which the Anatomiſts call the *Madulla Allongata*, by its two open Legs. Having deſcribed the upper Plain of the Brain, and being now to deſcribe the lower Plain, I ſay, that in the Baſis of that great Knob, which is ſeated in the fore-part of the Brain, there appear to be two Nerves faſtened, or to ſpeak more properly, hanging down, on each ſide one, which are diſtributed into that Membrane, which covereth the Cavity of thoſe Holes, which are placed immediately above the Mouth. From the Baſis of that firſt Pair of Knobs, which are immediately behind the Knob that is in the Fore-part of the Brain, from the ſame place the two Optick Nerves are derived, behind which, a little above or higher from the very ſame Knobs, the two *Nervi Motores* of the Eyes proceed. Theſe *Nervi Motores* of the Eyes, in their firſt Riſe or Source, are divided into two Branches, or as it ſeemeth to be, there ariſe from the ſaid Knobs two diſtinct Branches of Nerves, on each ſide two, ſo that in all they make four. Betwixt theſe two Nerves, or ſomething below them, the *Infundibulum* is placed, in the middle of two ſmall red Glandules, which are hooked like a Half-Moon. Behind this *Infundibulum* there ariſe two other Nerves, on each ſide one, which were called by Mr. *Willis Nervi Pathetici*, from the Uſe which he aſcribed to them; which ſaid Pathetick Nerves are derived from the ſame Pair of Knobs, from which the two Optick Nerves ariſe, as alſo the *Nervi Motores* of the Eyes; but they take their Riſe a little above the ſame Movers. Two Bundles of Nerves ariſe from the Baſis of the two laſt Knobs, on each ſide one, which are called the *Nervi Guſtatorii*, or Taſting Nerves, behind which alſo there ariſe two other ſmall Bundles of Nerves, on each ſide one, which are called the *Nervi Vagantes*, or Ramblers. All theſe Knobs of the Brain are empty, and hollow on the Inſide, which is evidently manifeſt, ſince in putting in any little Pipe, or Quill, the Wind viſibly cometh forth from them. The *Arteriæ Carotides* are inſinuated into, or enter the Brain, juſt after the ſame manner as they commonly do in Four-footed Beaſts, and ſo are united to the Trunk of the *Vertebræ*. For the better explication of which, I ſhall produce two Figures in the Fifth Table, which are marked with the Numbers 2 and 3, of which the Number 2 will ſhew the Plain, or upper part of the Brain; and in this

a, a, Repreſent the Great Knob, which is placed in the Fore-part of the Brain.
b, b, The firſt Pair of Knobs.
c, c, The ſecond Pair of Knobs.
d, The Body, which after certain manner repreſents the *Cerebellum* of Four-footed Beaſts.
e, e, The *Medulla Allongata.*

The Number 3 ſheweth the lower Plain of the Brain, with its Blood-Veſſels; and in this
a, a, a, a, a, Shew the five Knobs of which the Brain is compoſed.
b, b, The lateral Parts of that Body, which in ſome repreſenteth the *Cerebellum.*
c, c, That Body, which Anatomiſts call the *Medulla Allongata.*
d, d, The *Nervi Olfactorii*, or firſt Pair, which are derived from the Baſis of the great round Knob, which is ſeated in the Fore-part of the Brain.
e, e, The Optick Nerves, or ſecond Pair, which taketh their Riſe from the firſt Pair of Knobs.

f, The Union of, or joining of the Optick Nerves.

g, *g*, *h*, *h*, The *Nervi Motores* of the Eyes, or third Pair, which are derived alſo from the Baſis of the firſt Pair of Knobs.

i, *i*, The Pathetick Nerves, or fourth Pair, which come from the Baſis of the firſt Pair of Knobs.

k, *k*, The *Nervi Guſtatorii*, or fifth Pair.

l, *l*, The *Nervi Vagantes*, or ſixth Pair, which is like or correſpondeth with the eighth Pair of Quadrupeds.

m, *m*, The Trunks of the *Arteriæ Carotides*, when cut.

n, *n*, The foremoſt Branches of the *Arteriæ Carotides*, which being divided into ſeveral Branches, are ſpread through the Brain.

o, *o*, The two poſterior Branches of the *Arteriæ Carotides*, which being joined in *p*, paſs on in order to be united with the *Arteriæ Vertebrales*.

q, *q*, *q*, The three aſcending Branches of the Artery of the *Vertebræ*.

r, The uniting or joining of the three *Arteriæ Vertebrales*, in one only Branch.

ſ, The *Infundibulum*.

t, *t*, The two reddiſh Glandules of a hooked Figure, like that of a Half-Moon, which divide the *Infundibulum* in two.

I had almoſt forgot the Eyes, which are juſt ſo as Mr. *Francis Redi* hath deſcribed them. The Apple, or Sight of their Eye, is not round; for the *Iris* is of ſuch a Figure, that one half of it is concave or hollow, the other half is convex, and by the entring of the convex part into that which is hollow, the Sight is ſhut up. The Chryſtalline Humour is round, and of a tender Subſtance in the Outſide.

Having finiſhed the Deſcription of the Parts of the Cramp-Fiſh, I muſt now at laſt ſay ſomething of the ſtrange Properties or Qualities which are aſcribed to it.

In this all Authors agree, that theſe Fiſh are called *Torpedines* in *Latin*, *à Torpore*, *i. e.* Numneſs, from a certain Force which they have of introducing a Numneſs into thoſe Bodies which are near them; and this is what *Ariſtotle*, *Pliny*, *Ælianus*, *Albertus Magnus*, *Geſnerus*, *Salvianus*, *Aldrovandus*, and *Johnſtonus* do unanimouſly aſſert. But they do not all agree in this point, whether this ſtrange Vertue or Power reſideth equally in all Parts of the Body of the Cramp-Fiſh, or whether it be placed only in one particular Part: For *Salvianus*, who in this point is followed by many others, will have it to be in all the Parts of the Body. On the other ſide, it is the Opinion of *Diſilus*, *Oppianus*, and *Cardanus*, that it is confin'd to one Part only; yet withont aſſigning what Part that is. There are ſome others, who keeping the middle way, have not Courage enough to turn or encline, either to one ſide or other. Mr. *Francis Redi* ſaith in his Writings, that it ſeemed to him, that this ſtupefactive and dolorifick Virtue or Power, did reſide (more than in any other Part) in thoſe two hooked Bodies or Muſcles, which correſpond or anſwer to the Back and Breaſt of the Cramp-Fiſh, being formed of a certain ſoft Subſtance, which ſeemeth to be compoſed of ſo many Bladders full of Water, of ſeveral irregular Figures, as I have deſcribed them in the beginning of this Diſcourſe: But he, with his uſual Modeſty, had not Courage enough to aſſert and poſitively maintain it; and he doubted whether he might not be miſtaken, becauſe in thoſe Times he never had the fortune to ſee any more than that individual Cramp-Fiſh which he had deſcribed. I can freely aſſert from my frequent Experiments on that Subject, that Mr. *Francis Redi* was no ways miſtaken; and I again maintain and affirm, that that wonderful ſtupefactive and dolorifick Virtue reſideth in no other Place, but in thoſe two forementioned hooked Bodies, or Muſcles. Thoſe Perſons were much miſtaken, who believed and aſſerted, that the Virtue or Power of the Cramp-Fiſh, did not only operate by an immediate Touch, but that it alſo operated at a diſtance, the Virtue paſſing through the Nets of the Fiſhermen, Hooks or Spears with which they were touched or wounded. Whence *Pliny*, in his Ninth Book, Forty Second Chapter, and *Oppianus* in his *Halteutica*, were both very eaſily deceived, who have delivered it in their Writings, that the Cramp-Fiſh, in order to get their Prey, do hide themſelves in the muddy Places of the Sea, and that the Fiſh which came to paſs by them, remain caught, and nummed or ſtupified, and ſo conſequently devoured by the ſame Cramp-Fiſh. That alſo which *Godignus* writ or mentioned in his Relations of *Abyſſine*, is likewiſe a Fable, unleſs there is a mighty

difference

difference betwixt the Cramp-Fiſh of the *Æthiopick* Sea, and thoſe in the *Mediterranean.* I ſay it was a meer Fable, that a Cramp-Fiſh being put alive into a Basket full of dead Fiſh, thoſe Fiſh, when they were but once touched by the Cramp-Fiſh, they ſuddenly, as it ſeemed, returned to Life, ſince, as *Godigno* affirmeth, they toſſed themſelves to and fro, and were agitated by an inward Motion, which was without the Ken of Human Underſtanding. Mr. *Francis Redi* had not the Courage to contradict thoſe Trifles of the Virtue of the Cramp-Fiſh operating at a diſtance; yet he did certainly and poſitively affirm, that when he advanced his Hand near the Cramp-Fiſh, without touching it, and when he held his Hand in the ſame Water in which that ſame Fiſh ſwam, he neither felt any Numneſs, nor any Trouble or Inconvenience in his Hands at all: Therefore I ſhall here ſet down, for the better clearing the Matter of Fact, or Subject in hand, all the Experiments which I have frequently made on this occaſion, and I ſhall relate them ſincerely and faithfully, as I found them.

In the Year 1676, *February*, whilſt I was in the Service of my Moſt Serene Maſter the Prince of *Tuſcany*, his Moſt Serene Highneſs the Great Duke ſent me ſix Cramp-Fiſh of different bulks or dimenſions, which, becauſe they were ſwimming up and down together in a Veſſel which was filled with Salt Water, were very brisk and vigorous, and it ſeemed as if they had not ſuffered any thing at all, or very little. I reflecting what a vaſt quantity of ſtupefactive and dolorifick *Effluviums* muſt in all probability be exhaled from the Bodies of ſix Cramp-Fiſh, which were all together confined in one great Veſſel, begin to touch ſometimes one, ſometimes another, with a Stick, without perceiving or feeling any Pain or Numneſs in my Hands: Then having caſt away the Stick, I plunged my Hand into that Water, in which the Cramp-Fiſh glid or ſlipp'd up and down, and yet I was not ſenſible of the leaſt Inconvenience or Numneſs at all. Repeating the ſame Experiment on the very ſame Day, on theſe Fiſh, as well on other Days in other Cramp-Fiſh, it was always the ſame thing; neither I, nor any other who made trial of it, found any Inconvenience by it. I begin again to touch the Cramp-Fiſh with my naked Hands, as well in the Water as out of the Water, and my Hands were always ſo mightily nummed, that the Pain came up as far as the Point of the Elbow, not paſſing any farther; and always at other times, as often as I repeated the Experiment, the very ſame thing happened unto me, that is, I was nummed in my Arm even to the point of the Elbow, without paſſing any farther; which Accident or Paſſage makes againſt thoſe, who maintain, that the Numneſs and Pain is ſpread o'er all the Body. Mr. *Francis Redi* obſerved, that in touching his Cramp-Fiſh, the Numneſs reached or paſſed up even to his Shoulder.

The Numneſs and Pain, which are occaſioned by the touching of the Cramp-Fiſh, reſemble in ſome reſpects that Pain and Numneſs, which one feeleth by a Blow in the Point of the Elbow againſt ſome hard Body, and is ſo troubleſome, that it becometh in a manner inſupportable, which continueth for ſome ſmall time; after which, without leaving any Alteration at all in the Hand or Arm, it vaniſheth. And here in the firſt place we muſt obſerve, that when I tried theſe Experiments, I never found any Pain or Numneſs, but when upon touching or claſping thoſe two hooked Bodies, or Muſcles, the Fibres of which theſe Muſcles were compoſed, were contracted, not perceiving any Alteration at all, as long as the Fibres contained in their natural Situation, without being contracted at all. In the ſecond place, we muſt obſerve, that the Numneſs vaniſheth alſo, according to the difference of the Contractions of the Fibres: For when the ſame Fibres are vigorouſly contracted, at that time there is cauſed the greateſt Numneſs, and it doth not only affect the Hand, but the whole Elbow: When the Fibres are not ſo violently contracted, but ſomething more gently, then there is felt only a Numneſs in all the Hand, without its paſſing any farther; and when they are very gently contracted, then one only feeleth in the Fingers a kind of Convulſive Motion, which twitcheth one, as often as the Fibres are contracted, and when the Fibres are not contracted at all, there is no Alteration at all perceived in the Hand of him who toucheth them: So that then the Cauſe of this Stupefaction, or Numneſs, proceedeth purely from the Contraction of thoſe Fibres, of which the two hooked Muſcles are compoſed; which will appear manifeſt to any one, who ſhall make a trial of it, and can confeſs how erroneous their Opinion is, who will have it, that this ſtupefactive Power doth alſo reſide in the Bodies of thoſe Cramp-Fiſh which are dead. In the third place, we muſt obſerve, that when I did not actually touch the Cramp-Fiſh, tho' I held my Hand very near the Animal, and that the Animal wriggled and toſſed it ſelf up and down, with all this I never perceived the leaſt Pain, or Numneſs; and this is ſufficient to confute the Error and Impertinence of thoſe Fiſhermen, who ſay, that if one pour Salt or Sea-Water into a Veſſel in which there are any Cramp-Fiſh, one ſhall ſoon perceive a Numneſs in ones Arm. As for my ſelf, I never believed it, but I was willing to make a Trial of it, that I might be able to ſpeak of it with ſome certainty; and thence I ſaw how erroneous and falſe that Saying of the Fiſhermen was (as I always thought it) ſince that it did not ſeem to me any ways probable, that that Pain which conſiſteth in the pure Motion of the Fibres, can be any ways communicated to the Air or Water, and from thence to the Hand or Arm. It is really true, that the Pain or Numneſs, which they ſay they have felt on ſuch an occaſion, I ſhould be apt to impute to a ſtrong, but falſe Imagination, which operates on them after ſuch a manner, that they ſeem to feel that Pain: In confirmation of which I will here relate a particular Caſe, or Paſſage, which happened to me the laſt Year, whilſt I was intent on theſe Obſervations; for one of my Friends coming one day to ſee me, who was very deſirous to make ſome Experiment on the wonderful Virtue or Quality of Cramp-Fiſh, that he might be the better qualified to diſcourſe of it on more certain grounds, was willing I ſhould ſhew him ſome Experiment on this Subject. I comply'd with his Requeſt, and having placed an indifferent large Cramp-Fiſh on the Table, I hinted to him the Place which he was to touch, in order to feel the Numneſs; then he being very much afraid, began to put out his Arm, and having ſcarce advanced his Hand to the Back of the Cramp-Fiſh, without ſo much as touching it, he with all the quickneſs imaginable withdrew it, being altogether frighted, and affirming, that he felt a very ſharp Pain: But I reaſſuring him, and demonſtrating to him, that the bringing ones Hand to it, was not enough to make one feel the Pain, but that it was alſo neceſſary to touch and claſp thoſe two hooked Bodies; being then grown more couragious, he often put his Hand near the Fiſh, without ever feeling any Pain; and when he touched and claſped thoſe two hooked Bodies, and that the Cramp-Fiſh wriggled himſelf up and down, then he was really ſenſible of the true Pain, and true Numneſs, and not one that was purely imaginary, as he afterwards laughing at himſelf freely confeſſed to me. Mr. *Oliver James*, and Mr. *Chriſtopher Bartholin* were alſo willing to make ſuch another Experiment, and they both of them became ſenſible of that Pain and Stupefaction. Thinking my ſelf then to be fully ſatisfied in this point, I reſolved to make the following Experiments with the ſame Cramp-Fiſh, ſince they had not loſt any thing of their natural Vigour.

I put a Cramp-Fiſh into a Napkin, I held the Napkin up in the Air with my Hands, to try whether the Cramp-Fiſh might produce any Alteration in my Hand; but to ſay the truth, I perceived not the leaſt Alteration at all, tho' the Cramp-Fiſh ſlip'd, and wriggl'd himſelf up and down: And this Experiment was made by me, and many others, as well in the Water, as in the Air; but becauſe I doubted, whether the Cramp-Fiſh might not have this ſtrange Virtue of theirs more active and vigorous when they were at Sea, and conſequently that it might be true, that upon the drawing of the Nets, in which the Cramp-Fiſh were caught or taken, the Hand and Arms of the Fiſhermen were really numn'd, I once caſt my ſelf down expreſly on the Shore, in order to touch and draw the Fiſherman's Net, at the ſame time when there were ſome Cramp-Fiſh taken together with others in the ſame Net; but I felt no Pain, nor any Alteration at all in my Hands; whence thoſe Fiſhermen began to ſay, that if one would have the Cramp-Fiſh produce thoſe wonderful Effects, it was neceſſary to touch it with ſome Part of the Body which was naked or bare; and in fact, on the ſame Sea-ſhore I ſeveral times preſs'd the Cramp-Fiſh with my bare Foot, and never felt any Pain or Numneſs at all. Then I put all the Cramp-Fiſh, which were alive and vigorous, in a Veſſel together with other dead Fiſh; but I never obſerved, that thoſe Fiſh ſhewed any inward Motion at all, nor did any one of thoſe who were there preſent alſo, perceive any ſuch thing; but thoſe Fiſh being ſtiff, paſs'd here and there in the Water, according as they were driven by the Cramp-Fiſh in their ſwimming; and I try'd the ſame Experiment alſo out of the Water on a Table; but here alſo thoſe Fiſh ſhewed no Motion at all either inward or outward.

Theſe are the Experiments which I made, for a Concluſion of which, I affirm and maintain, that the Cramp-Fiſh hath not this ſtupifying Quality in all the Parts of his whole Body, but only in one particular Part, and that this determin'd or particular Part is thoſe two hooked Muſcles, which are deſcribed before, which unleſs they are immediately touched with the bare Fleſh, produce no Effect at all; and beſides, in touching thoſe Parts, it is neceſſary that the Fibres of thoſe ſaid Muſcles be contracted, to produce the Effect on the naked Part of thoſe who touch them.

This point being confirmed, it is neceſſary to ſay ſomething about the Occaſion or Cauſe of the Numneſs which is produced by the Contraction of the foreſaid Fibres, when they are touch'd. Perhaps it will be impoſſible for to produce the true Cauſe of it, and I am contented in producing that which is only probable, referring my ſelf ſtill to their better Judgment, who are older, and more experienced.

I lay down this as a Principle, that our Body cannot be any ways affected, either with Delight or Pain, without the Means or Mediation of ſome other Body, which muſt touch it immediately, or inſinuate it ſelf into it: And this Suppoſition is well known, and judg'd true by the better ſort of Philoſophers. This then being granted, I ſhould be apt to ſay, that this Numneſs or Pain, which is occaſioned or produced by the Cramp-Fiſh, proceedeth from abundance of certain Corpuſcles or *Effluviums*, which coming from the Cramp-Fiſh, enter into his Hand who toucheth it. Theſe Corpuſcles or *Effluviums* do not come thence of themſelves, but they are driven, and as it were darted forth by the Contraction of thoſe Fibres, of which thoſe two hooked Bodies, or Muſcles, are compoſed: And becauſe the Pain which they cauſe is ſometimes greater, ſometimes leſſer, the Reaſon of that Particular is this, That there is a greater quantity of thoſe Corpuſcles at one time, than there is at another; to which may be added, that the Pores or Paſſages through which the ſaid Corpuſcles violently penetrate into the Body, are not always ſo juſtly fitted or adapted to the Figures of the ſaid Corpuſcles. How theſe Corpuſcles, which are darted by the Contraction of the Fibres of the Cramp-Fiſh, enter into his Hand who toucheth it, I am apt to think it is performed after the manner following.

It is no difficult Matter to believe, that there are in living Bodies many Paſſages thro' which theſe Corpuſcles, or *Effluviums*, or any others, may enter in or come out, as we daily ſee it is in the Baths, and in certain Medicines, which being applied to the outward Superficies of the Body, convey their Virtue into the moſt inward Parts of the ſaid Body, as I could prove by many Inſtances or Examples; but I ſhall here only produce that of the *Cantharides*, which being applied outwardly either to the Thighs or Arms, or any other Place or Part of our Body, do often produce exceſſive Pains in making Water, and ſometimes a bloody Urine. In the ſecond place, it is no hard matter to believe, that through ſome Paſſages ſome particular Corpuſcles cannot paſs, without forcing or extending the ſaid Paſſages or Pores, whence there followeth a Pain; ſome other Corpuſcles cannot penetrate through thoſe ſame Paſſages at all, by reaſon of the vaſt diverſity of Fibres; and other Corpuſcles do eaſily paſs there, without Pain, or rather with ſome Pleaſure, provided they are not overmuch multiplied, or in too great a Crowd, and that they move too impetuouſly: For there always ariſeth a Diſcontinuation of the Parts, and conſequently Pain (as Phyſicians commonly ſay) from the exceſſive quantity of theſe *Effluviums*, or from their too violent Motion. Pain alſo proceedeth from the changing of the Figures of thoſe Pores or Paſſages, through which the Corpuſcles at firſt paſſed eaſily; for in this caſe they would not paſs ſo eaſily, but they would needs uſe ſome Force to reduce them to their firſt and uſual Figure, by which they would cauſe ſome troubleſome Senſation: And this, as I believe, happeneth in the Numbneſs and itching or pricking of the Hands and Feet, or any other Parts of the Body, when with an extraordinary uneaſineſs they have changed their natural Poſition, and thence their inward Paſſages have changed their Figure, and conſequently thoſe Bodies, which uſed to enter in or come out at thoſe Paſſages, which were fitted and proportioned to them, cannot paſs there any more with that eaſineſs as they did before; and when any Part of our Body is in any ſtrange and uneaſy Poſture, the inviſible Paſſages do not only change their Figure, but the viſible alſo, as the Blood-Veſſels, the Lymphaticks, the Ramifications of the Nerves, and alſo thoſe Spaces, which by Phyſicians are called *Spatia Ovaria*; from whence it followeth, that the fluid

Particles being hindred from paſſing through thoſe ways or places, in the ſame quantity as they there paſſed at firſt, there is made a ſudden Collection of them, and ſo by forcing thoſe Parts in which they are received, to ſuch a degree, they cauſe that Numneſs and Pricking, which encreaſeth and groweth more ſenſible at that time, when the Part which now began to have a Numneſs, recovering its natural Situation, that is to ſay, the Paſſages being reſtored to their natural and firſt Figure, thoſe fluid Particles, which were kept there, run all together in a Crowd, precipitately, or one great part of them, in order to purſue their old Road or Paſſage. I ſhould then at leaſt believe, by way of conjecture, that the Numneſs and Pain of the Hand, when it toucheth and claſpeth the Cramp-Fiſh, may be occaſioned or produced from the darting of certain Corpuſcles or *Effluviums* into the Hand, which Corpuſcles paſs through certain Pores, which are well fitted to their Figures; or if they are proportioned, they paſs there in ſo great a quantity, with ſo great a Force or *Impetus*, that they thereby produce that painful Senſation: Juſt as we find it in that Affection, which we call Heat, which in reality is nothing elſe but a certain Touching, occaſioned by the Crowd of very ſmall Corpuſcles, which penetrate into the Subſtance of our Body, which according as they prick and penetrate in a greater or leſſer quantity, and with a greater or leſſer quickneſs, produce in us that Affection, which is ſometimes pleaſant and grateful, and ſometimes more or leſs troubleſome. And I am well aſſured that this Opinion will not appear new or ſtrange to thoſe who aim at nothing more than the noble Inquiſition after Truth, ſince it was diſcovered to us in former Times, by that Great Light and Reſtorer of Philoſophy, our Famous *Galileo Galilei*, and plainly taught us in his moſt exquiſite Eſſayer.

We are not then to wonder why the Pain is ſo troubleſome, ſince we muſt conſider, that thoſe Corpuſcles or *Effluviums*, which being darted forth from the Cramp Fiſh upon the Contraction of their Fibres, do paſs a-croſs the Hand, do alſo paſs croſs the Tendins, in which, as Mr. *Nicholaus Steno* hath obſerved, there are as many Fibres as there are in the Belly of a Muſcle, yet with this difference, that in the Tendins the Fibres are more cloſely united and joined to each other, and in the Belly of the Muſcles they are ranged at a greater diſtance, and ſtand not ſo thick; whence it followeth, that thoſe Corpuſcles which cauſe Pain, in paſſing croſs the Tendins, becauſe there are more Fibres there, and more united or more cloſe, they touch and move more of them at the ſame time; and ſo by touching many of them together, they produce that Pain which is ſo intenſe, which being communicated to the fleſhy Fibres, which are continued or joined to the Tendinous ones, is the reaſon, that when the Cramp-Fiſh, moveth himſelf vigorouſly or briskly, the Pain reacheth even to the Elbow; and that this perhaps is the cauſe of that ſo violent and ſo intenſe Pain, may be confirmed from an Experiment which I have often made, which is this, That if the Cramp-Fiſh is touched or ſqueezed with the Finger, that is to ſay, with the Tendins, the Pain is then much greater and more acute; but if the ſame Cramp-Fiſh is touched or preſſed with the naked Arm, that is to ſay, with the Fleſh, it is true one feeleth a Pain, but more blunt, and much leſſer than what is felt, when the Cramp-Fiſh is touched with the Finger: Nor can this be aſcribed to that to which ſome aſcribe it, that is, that when one toucheth the Cramp-Fiſh with ones naked Arm, ſhe moveth her ſelf more gently, and not ſo briskly, or with that vigour, as when ſhe is touched or ſqueezed with ones Hand. But I have made ſo many Experiments and Trials on this Subject, and ſo often, that I believe I am not miſtaken in it; and I again am apt to believe, that the Senſation which is occaſioned in the Tendins, is much more painful than that which is cauſed in the fleſhy Parts; which is alſo confirmed by obſerving, that the Motions and Signs of Pain, which an Animal maketh when it is wounded in the Fleſhy Part, and then when it is wounded in the Tendins, do much differ from them; for the Signs of Pain and Uneaſineſs are much greater, and much more evident at that time when it is wounded in the Tendins, than it is when it is wounded in the Fleſhy Parts, for the ſame reaſon which I produced before, and which hath been very well obſerved by Mr. *Gaſpar Bartholini*, in his Letter about the uſe of the Nerves in the Motion of the Muſcles.

FINIS.

75 on the Cramp-Fiſh

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